THE

ELECTRICAL REVIEW.

VOL. XXXIX. SEPTEMBER 4, 1896. No. 980.

CONTENTS:

	PAGE
The Value of Refuse Destructors: Some Tests at Oldham ...	287
Tramway Working	288
Electrical Resistance...	288
Lightning Protecting Devices for Heavy Current Installations (*illustrated*) (*concluded*)...	290
Lead or Lag?	291
Connecting Incandescent Lamps in Series on Alternating Currents (*illustrated*)	292
On the Measurement of the Insulation Resistance of Street Railway Cables (*illustrated*)	293
A Method of Comparing the Electromotive Forces of Batteries (*illustrated*)	294
Combined Alternating and Continuous Current Dynamos ...	295
Trading Dishonesty in Japan	295
Transmission of Power in Mines.—III. (*illustrated*)	296
Reviews	297
Books Received	298
Scott's Bamboo Trolley Mast (*illustrated*)...	298
The Calculation of the Conductivity of Mixtures in Electrolytes	299
Raworth's High-Speed Universal Engine (*illustrated*)	300
Correspondence:—"A Problem in Electro-dynamics" (*illus.*)	301
The Blackpool Installation	301
Business Notices, &c....	302
Electric Lighting Notes	303
Electric Traction and Motive Power Notes	303
Telegraph and Telephone Notes	304
Contracts Open and Closed	304
Notes	305
City Notes	310
Traffic Receipts	310
Share List of Electrical Companies	311
A Modern Village Lighting Plant—Norwood, Ohio	312
International Telegraph Conference at Buda-Pesth	313
Locomotives on Highways Act, 1896	314
The International Congress of Electricians at Geneva (*continued*)	315
Electric and Magnetic Research at Low Temperatures (*illustrated*) (*continued*)	316
New Patents	317
Abstracts of Published Specifications	318

THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).

PRICE 6/- POST FREE.
The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

1896 ISSUE.

PRICE 6/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,
22, Paternoster Row, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address: "AGEEKAY, LONDON." Code A B C. Telephone No. 6,933.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other countries*, per Year, £1 4s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s. or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 22, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 22, Paternoster Row, E.C.

THE VALUE OF REFUSE DESTRUCTORS: SOME TESTS AT OLDHAM.

UNDER the above heading, we notice in the columns of a contemporary a mild and rather tentative jubilation over an extension of the destructor plant at Oldham, and the records of certain tests.

It seemed to us that the Horsfall destructor at Oldham was familiar in connection with the now dead "boom" in destructors as substantial aids in electric lighting. So we looked up the matter.

In September, 1892 (see *Engineering*, September 30th, 1892), Mr. Watson read a paper before the British Association, in which he gave certain results which he had obtained from the Horsfall destructor at Oldham. He also made certain claims as to what would be obtained under better conditions, and gave "A calculation based upon analyses of the products of combustion of Mr. Horsfall's experimental furnace at Leeds, in 1888, and upon the specific heats and weights of the component gases," which promised much greater results.

These figures, reduced to the common basis of pounds of water evaporated per pound of refuse burnt, were:—

As realised ...	0·38 lb. net—	deducting steam used in blowing jets
As claimed ...	0·54 lb. net—	deducting steam used in blowing jets
Theoretical ...	2·13.	

The corresponding figure now given is 0·328 lb.

It is fair to state that the pressure was 127·2 lbs. in the latter case and 70 lb. in the former; but, in the absence of information as to feed temperature, we cannot reduce the two to a common basis.

Practically the correction is unimportant. The broad fact is, that according to the figures this destructor stands as a steam raiser where it did four years ago.

The fact on the electrical engineering side is, that this result is not nearly good enough. It was the promised increase, and still more the alluring theoretical possibility upon which the boom started, not the mere attained results.

Our opinion is now as it was at the time of the boom: If a municipality want destructors—which are very excellent in their own sphere—and if the best or only site available for the electric light station is on the same site as the destructor, then the electrical engineer will take all the steam you can give him; but he certainly will not, if he is wise, design his station as if the waste heat of the destructors were an important consideration; still less will he move his station any distance from the best electrical position on account of this waste heat.

Meanwhile the Horsfall Destructor Company are entitled to whatever credit attaches to having raised steam at 127·2 lbs. pressure at the rate of 2,418 lbs. per hour, from

the refuse collected from a population of 136,469 *for 24 hours at a stretch.*

We should add that, knowing a little about the varying quality of refuse, we would accept no results based upon a 24 hours' test.

TRAMWAY WORKING.

Commenting on the so-called predicament of the Tramways Sub-Committee of Glasgow, as to how to work the tramways, our contemporary, the *Engineer*, quite forgets that committeemen are mortal. A tour of investigation to Brussels, Rouen, Paris, Hanover, Hamburg, Berlin, Dresden, Buda Pesth, Milan, and Genoa, was doubtless exceedingly onerous to the gentlemen who sacrificed themselves so that Glasgow might flourish, and it is startling that they should even have reported in favour of the overhead electric system, and recommend that a trial of this be made. But this was not enough for the other members. A larger deputation yet had to forego the pleasures of their bright city, and extend their researches into the hidden mysteries of nature and science, as revealed in Continental cities, and perhaps there may yet be a third deputation abroad, for the General Council has remitted the question to the Committee. The *Engineer* inclines to such systems as render a car independent of a base. But does any system do this other than steam, and even steam is only partially independent, for water and coal must be picked up even by the steam car. Next surely comes the gas system, with compressed gas laid on so as to be picked up by the car at frequent intervals along the line, but the exhaust of a gas engine is not a pleasant thing, especially in a city. There remains practically only the overhead electrical system, and no one can say that the architecture of Glasgow would suffer by the addition of a well-disposed overhead system. If a steam system is to be a success anywhere, it ought to be so in Glasgow. The Serpollet steam motor acts well in Paris. The water in Glasgow is so absolutely soft and pure that the Serpollet motor and boiler will work nowhere if not in Glasgow; but even the Serpollet engine has an exhaust, and emits fumes from its furnace.

Speaking of electrically propelled cars, the *Engineer* remarks that so long as the electrician demands a pair of 15-horse or even a pair of 25-horse motors on each car the system is not likely to be one of low working costs. This large power alone seems to have placed electrical working on a sound basis in America, but we cannot overlook the fact that such a thing as the English suburban train service has hardly an existence in America, but that it was needed there, and has really been undertaken by the electrical lines, and for much of the Glasgow tramway work in which a high speed is inadmissible, it is very doubtful if very large powers of motors are really needful for this ordinary city traffic, that is, as maxima. It need hardly be said that the *average* horse-power exerted does not reach anything like this amount, and the *Engineer* surely ought to know it. By the way, electrical engineers might with advantage note that the gas engine has good starting capacity. It continues to run when idle with very small expenditure, and always has a stored up fly-wheel energy to restart the car. Simplicity of gearing may be a good thing, but there is a good deal to be said for less direct methods, especially as these need not be specially complicated. So long as the Glasgow municipal authorities are so uncertain as to the means to be adopted, we should think a seat on the sub-committee will be much sought after.

ELECTRICAL RESISTANCES.

The discussion on the nature of the arc has raised the question as to what is resistance? Roughly defined, a resistance is anything which opposes electrical pressure, E.M.F., or force due to P.D. The resistances which obey Ohm's laws are not the only ones which we find in opposition to electrical force; in electrolysis, the current is proportional not only to ohmic resistance, but also to the counter E.M.F. Here, however, we are able to measure each separately, and so are able to make distinctions between them, and say how much of the opposition is due to ohmic resistance.

In alternating current measurements we have ohmic resistances, impedance, and the skin effect in thick conductors; in this case, as in the last, we are able to distinguish the various oppositions, and give them different names.

In the electric arc we have resistance of some kind—probably of many—but the difficulty here is to measure any one of them apart from the others; all of them must of necessity be in operation at the same time. There may be no true ohmic resistance in the arc, a condition, however, hardly realisable; there may be back E.M.F. due to difference of temperatures and to combustion, but no researches have yet been able to give any positive idea as to what kind of opposition it is in the electric arc which requires about 40 volts to overcome and force 10 or 12 amperes through. The fact that the arc cannot be maintained under about 30 volts would favour the idea that counter E.M.F. to nearly that value exists; on the other hand, the heat generated can be accounted for only, one would imagine, by ohmic resistance, either at the surfaces or in the arc column itself.

An arc column may be fixed approximately in length by automatic means, but it is always free to alter in area of cross section, and this element makes it still more difficult to distinguish the different effects in an arc.

It will require much better proof than any yet advanced to establish the existence of "negative" resistance in the arc or anywhere else, but we are curious to know from whence the heat in the arc arises, if the arc has no ohmic resistance whatever.

The Government and the Electrical Trade.

The present Government, or, at all events, several members of the Cabinet, have, since they came into office, proved themselves to be thorough business men as well as efficient statesmen. They have gained for the Unionist Government of 1895 a reputation for having devoted a great deal of attention to the development of British trade and commerce, and have added to our prosperity at home and our commercial success abroad. Such endeavours on the part of any government commend themselves to the English merchant and man of business, and are also estimated to bring support to that Government from the working classes, who are generally benefited in a large degree by the extension of trade. The set of ministers which undertakes such a work as this must necessarily find plenty to do, and as it investigates matters, cannot fail to discover many grievances of one kind and another which need remedying. Not only, however, will grievances be brought to light, but a thousand and one little and apparently unimportant ways may present themselves whereby the Government could, with a trifling effort, assist the manufacturer to keep in touch with the world. The advantages of this kind possessed by Government

officials are exceedingly valuable from a commercial point of view, for the trades might hear from such quarters of contracts open abroad which otherwise they would never know of until some foreign house had secured the order. A contemporary, having an instance before it where the Government might perhaps have helped but did not, communicated with the Foreign Office asking that particulars of open contracts of an electrical character might be sent to it, as a trade journal. The Marquess of Salisbury may have a fine sense of humour, and at first reading we almost thought his reply was written in that spirit, but it is really intended in all seriousness, and we reproduce it as a specimen of what appears to be a want of appreciation of the importance of the electro-technical industry of this country, such as we should not have expected from his Lordship :—

With reference to your letter expressing a wish to be regularly supplied with information respecting the invitation of tenders abroad, I am directed by the Marquess of Salisbury to state that the supply of such information to the technical Press cannot be undertaken by this Office, but that *all information on these subjects may be obtained from the daily Press.*—I am, Sir, your most obedient, humble servant, F. H. Villiers.

Our contemporary has just cause for complaint at such a reply. Fancy the technical Press copying technical information from the newspaper Press, which is for ever blundering over electrical news and mutilating it! Should it not be the daily Press to copy from the technical? Then accuracy would be assured. We may be pardoned for believing that were such a communication addressed to the Colonial Office, a very different reply would be received.

The Question of Salaries.

The commencing salary of an electrical engineer depends upon various considerations, but chiefly should it depend upon his electrical knowledge and experience, and his fitness for the particular position which he may be called upon to hold. During the past year or two the question of what is a fair and legitimate salary for a thoroughly efficient man has occupied many minds in the electrical world, particularly in England. Municipal bodies are too prone in these days of economic considerations to practice what at times proves to be a false economy, by giving to a professional man—whose knowledge has been secured only by hard study and at great expense in years gone by—a salary which, in some instances, has been little more than the pay of mechanics or fitters. For this salary they expect to secure an electrical engineer who is almost the cream of the profession, but their expectations are frequently unrealised, for a man having the interests of his profession at heart will, when he can afford it, wait for a better and more remunerative opening rather than reduce the standard by taking a position at what might be classed, at least, as an unreasonable salary. We can understand, now that electric lighting is becoming so general and central stations are running in most towns of importance, that such a state of affairs has become possible, for it seems to be the usual course in almost every business as it extends and as competition increases. Happily, however, there are not many instances in this country where borough electrical engineers are paid less than £200 per annum, but there *are* several. We should not like to say that in any of these instances incompetent engineers have been appointed. Such may or may not be the case. We sincerely hope for the good of electric lighting that they are not incompetent, yet we wish for the good of the profession as a whole that we might feel that good men are not to be secured at low rates. The borough electrical engineer is no common workman or mechanic. He has to undertake the responsibility of running his station and superintending the entire installation, and he is only competent to do this after years of knowledge purchased in the school of practical experience. Electrical engineers should look at this matter carefully, for low remuneration can only eventually lead people to suppose the profession to be one of mediocrity. These considerations should be particularly borne in mind now that electric traction business is beginning to move. As everybody knows, the Leeds Town Council has a line of electric tramways in course of construction, and recently advertised for "a clerk of works" to superintend the electrical equipment of the line. He is understood to have to take over the management and to advise regarding extensions. The salaries asked by the five applicants who were seen by the Tramways Committee ranged from £2 5s. to £5 15s. per week. The successful man, who asked £3 3s., had had experience on the old Roundhay electric tramway, and was appointed by a majority of one in committee. We think the salary quite inadequate for a man so fully competent, as the successful candidate must be, to advise a Corporation on such an important matter as that of electric traction, for his responsibilities are many, and of a grave nature.

Cataphoresis.

This was the subject of an address which was recently delivered by Dr. Wm. J. Morton, at a meeting of the Dental Society of New York. The word "Cataphoresis" is a curious word to use, since it comes from the Greek words κατα meaning downward, and φορειν, meaning to travel, tend, or trend; so that cataphoresis means travelling downward, and it is evident that it was borrowed from the notion of the old electricians, who had the idea that there was a positive potential, which was upward, and a negative potential which was downward in this operation. As used by the American dentists, the word refers to the flow of fluids from the positive to the negative pole. If these fluids contain chemicals in solution that make them medicines, then the medicines flow from the positive pole to the negative pole, and if the tissue or skin is made a positive pole, and some distant part the negative, or *vice versâ*, the medicines have a tendency to flow with the current. The selection of a good name is often important, but so long as American dentists understand what they mean, there is no particular reason why they should fly from "cataphoresis" to such terms as "electric osmosis," "anodal diffusion," "metallic electrolysis," "anaphoresis," "interstitial electrolysis," "electric transfer of particles and fluids," "electric transportation," "electrical medicamental diffusion" or "electric fluid diffusion." Dr. Morton's address is of an extremely elementary nature, and was advisedly so, inasmuch as he had to put a theory forward before his brother dentists concerning which it was presumed they knew apparently little. It is none the less important, however, on that account. We are surprised, ourselves, at the numerous applications of electrical treatment which are now in common practice amongst the best dentists in America. Local anæsthesia of the skin or mucous membranes can be produced very quickly by means of cocaine and a very simple electric apparatus. Guaiacol has also been used by Dr. Morton for producing local anæsthesia electrically; hence the operation of tooth-benumbing can be performed with absolute certainty, and so painless dentistry becomes a fact and not a mere shibboleth to advertise with. Then, too, tooth-bleaching and many other operations of a minor surgical nature can be most suitably performed. The interesting part of the address, perhaps, to our readers, is that which refers to the possibility of using the current from the mains running past the dentists' houses. Dr. Morton strongly advises his brother dentists to make use of the current which may be supplied to their houses. He, himself, uses a system devised by Vetter, who employs a lamp, cuts down the voltage from 110 to 60, and then cuts that down by the aid of a rehostat. Altogether, it seems to us, on reading this address, for the publication of which we are indebted to the *Electrical Journal*, that dentists in America are a long way ahead of their contemporaries in this country, and it would certainly be a useful thing for some of our electricians, by means of papers read before gatherings of English dentists, to endeavour to show them to what extent it is possible for electricity to aid them in their practice.

LIGHTNING PROTECTING DEVICES FOR HEAVY CURRENT INSTALLATIONS.*

Experience of German Institutions.

(*Concluded from page* 261.)

For the experiments there was available a transformer having a ratio of conversion of 200 to 20,000, although the pressure could be raised by means of an accessory machine having a maximum pressure of 2·8 times higher than the mean, temporarily up to 48,000 and 50,000 volts. The transformer was constructed on the core type, without oil insulation, and at high pressure it manifested some noteworthy phenomena which are referred to in the following.

First Test.

The first test was devoted to the investigation of some protecting apparatus. One consisted of alternating and superimposed layers of carbon discs of about 3 mm. thick, and paraffined paper in a glass tube 70 mm. high; the other was composed of alternating layers of zinc discs of 4 mm., and of mica of the same depth.

The method of testing is indicated in fig. 5; T represents

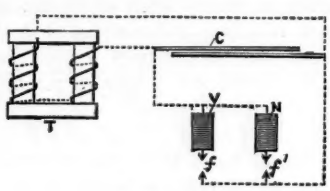


Fig. 5.

the transformer, C, a condenser, V, the protecting device, with zinc discs, N, that with carbon discs, and f and f^1, are sparking spaces. In order to obtain simultaneous discharges at V and N, the ratio of the sparking space was N : V = 2 (f^1) : 3 (f).

With equal sparking spaces, the discharge commenced earlier at V; 10,000 to 12,000 volts passed through V and N, this causing the paper discs in N to burn, whilst at V the metal began to melt, owing to the formation of the arc. It is to be noted that the device, N, was said to effect an obscure discharge, but the experiments did not confirm this. A cluster of discharges was noticed between the carbon discs, and, lastly, the sparks passed through.

A large Geissler tube of about 2 L capacity was then inserted parallel to N and V, and the discharges produced as previously. It was found with 70 times greater distance of the electrodes, as compared with the air space of N, the discharges were equally powerful. When, however, the transformer was supplied with continuous current and a switch inserted so that the discharges occurred with sound on account of the long charging period, the value of the tubes fell as compared with V and N; the tubes were shaken and vibrated.

The result of this test is that Geissler tubes are well suitable for discharges which take place without vibration or sound, but that for the explosive kind of discharge they are not suitable.

Such a kind of discharge as occurs without noise takes place, for instance, in the network of a tramway, as owing

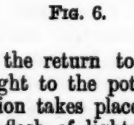


Fig. 6.

to the connection of the return to the earth, the trolley wire network is brought to the potential of the earth. If a powerful compensation takes place in the neighbourhood in consequence of a flash of lightning, the charge at the same moment as the earth potential changes passes from the conductor, and in case the path through the generators is followed, destroys principally the armature coils, and then strikes the iron.

In order to be applicable to the purpose, the Geissler tubes must naturally be of a durable form, something after the type depicted in fig. 6, and instead of a vacuum, be filled with diluted muriatic acid gas.

Second Test.

According to experience, lightning discharges which strike a wire conductor readily pass from the latter into buildings; they thus prefer the path through a sparking space. This is to be attributed to self-induction, which is produced in the wire in consequence of the extraordinary rapidity of the discharge, and the great current strength. If an induction coil is inserted in the conductor, it may safely be expected that the lightning will spring from the coil. The addition of iron will further increase the induction, since, as is well known, the lightning discharge current is disposed to magnetise the iron.

With a view to determine whether an induction coil would afford an absolute protection for the generators, the writer hit upon the testing arrangement shown in fig. 7.

Fig. 7.

The before-mentioned transformer, T, was fed from the generator, whose maximum pressure was about 2·8 times higher than the mean, so that a maximum pressure of 50,000 volts was obtained.

In the testing room, at a distance of about 15 metres from the transformer, was arranged on glass feet a conductor, L, which was connected directly to one of the poles of the transformer by means of the junction wire, l. The other led to the metal plate, P, near the transformer, with the condenser, C, placed between, whilst at a distance of about 10 metres was arranged a second metal plate, P_I, and behind that a sparking space, f. Connected with this was a second transformer, T_I, of low pressure and high current strength, once before the induction resistance and once after it.

In order to see in what ratio the space between P and P_I was charged, a third plate, P_{II}, was erected and connected, as shown, with the static voltmeter, V. The following ratios were ascertained:—

Pressure in transformer ...	3,000,	3,500,	6,000,	7,500.
„ room ...	1,200,	1,600,	2,500,	3,000.

The potential in the room decreased with the distance from the transformer, although with the highest pressure at the transformer and 10 metres distant from the plate, P_I, a sparking space (f) of 2 to 3 centimetres was overcome. Even without the junction wire, l, although the sparking space was considerably less, and such a powerful discharge took place between the winding and iron of the transformer, that for one-third of its surface it was enveloped in a faint violet light, the transmission was successful. Visible discharges also were noticed on the walls and ceiling. The discharge at the sparking space, f, was equal to about the 50,000th part of an actual flash of lightning.

As soon as the sparking space, f, had been struck by T, the transformer, T_I, maintained the arc, although on reading the current at I and II, no essential difference resulted. Thus, in this way, the proof that no kind of lightning discharge takes place through the induction resistance did not completely succeed. The cause of the lack of success lay with T_I as T, but not T_I, discharged sufficiently rapidly, and

* The *Elektrotechnische Zeitschrift*, June 18th, 1896.

only the joint working of the rapidity of the discharge with a high current strength produced the effective counter induction resistance. It may, nevertheless, safely be assumed from numerous cases gained from experience, that a lightning kind of discharge in no way overcomes an induction coil, but, on the contrary, springs before it, and thus a sufficient protection is obtained for machines and apparatus against actual lightning discharges.

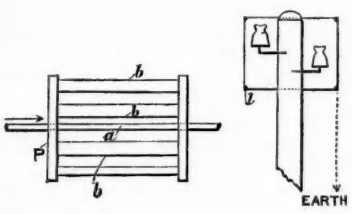
Third Test.

During the second test, the following observation was made:—

Of the four quadrants of the static voltmeter two were connected with the surrounding metal case. When the conductor, l_1 (fig. 7), was connected with the quadrants which were connected with the case, and l left quite free, no eruption took place; the charge in the available space was thus unable to charge the two other quadrants through the case. The eruption occurred immediately when l_1 was connected to the latter quadrants.

An analogy to this is to be found in the Hertz experiments and in the so-called electric birdcage (fig. 8). Waves coming laterally do not penetrate the protecting wire, b, b; the wires protect the conductor, a. Consequently the arrangement represented in fig. 9, as already employed in

Fig. 8. Fig. 9.



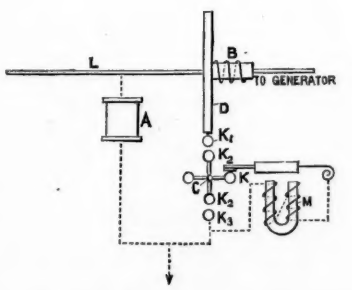


Fig. 10.

practice, should afford a sufficient protection against such a kind of charge. Waves coming in the direction of the arrow, as in fig. 8, will be turned by the disc P to b, b.

Result of Tests.

The result of the tests made is that machines and apparatus must be protected in different ways from atmospheric discharges, according to the nature of the discharge, that a so-called lightning protector must be a device which is composed of several apparatus. Such an apparatus must therefore contain:—

1. An apparatus which leads away discharges, to which the property of condenser charges belongs, with such a great sparking space (distance between the electrodes), that the generator current is no longer able to maintain the arc, for which Geissler tubes filled with rarefied gas are suitable.

2. A device to convey to earth discharges with flashes of lightning; for this purpose an induction coil connected to earth, and having a spark extinguisher, is suitable, and is to be inserted outside the machine or apparatus.

3. An electrostatic screen.

Fig. 10 represents such an arrangement. A is the apparatus for the conducting away of still discharges, B is the induction coil, C the spark extinguisher, and D the electrostatic screen. No further explanation is required of A, B and D, the spark extinguisher, C, only needing any description. It consists of the electro-magnet, M, the armature, K, a wheel capable of rotation round the shaft, a, the ends of which terminate in knobs, K_2, and from the conducting away knobs, K_1 and K_3.

A flash of lightning striking the conductor, L, in consequence of the induction effects of the coil, B, passes to earth through the sparking space, K_1, K_2, and K_2, K_3. The generator current passing produces a difference of potential between K_2, K_3, so that the current flowing through M attracts the armature, and sets the wheel in rotation, whereby the arc between K_1, K_2, and K_2, K_3, is broken, and the armature falls away. Then the operation would be ready for repetition.

The Elektrotechnische Gesellschaft, of Leipsig, submits the following, which is due to a commission consisting of Herren Paul Kohn, Doederlein, Gruhl, Lindner, and Dr. V. Oettingen.

1. Protectors consisting of two grooved brass plates, arranged opposite to one another upon a hard rubber insulator, are entirely unsuitable and useless, since even with a slight lightning discharge they fuse together, and establish a permanent earth.

2. The lightning protecting devices in use in the district covered by the experience of the commission are of the types made by Schuckert Company, Siemens & Halske, and the Allgemeine Elecktricitats Gesellschaft. These are either provided with a manifold divided sparking space, or possess an automatic spark extinguishing apparatus.

3. No experience has been obtained which would speak for or against any of these types.

At all events, expression has been given during the deliberations of the Society, to the view that the question of a suitable form of construction of lightning protecting devices is not yet solved, and in consequence of the lack of an apparatus which is known to be safe in working, the use of any such devices has almost entirely been dispensed with.

It would therefore be to the general interest to learn as soon as possible the experience of others with this or that type of device, in order that the prevailing obscurity may be removed.

LEAD OR LAG?

By W. G. RHODES, M.Sc.

A vexed question amongst electricians, both at home and abroad, seems to be the nature of the effect when a condenser is placed in an alternating current circuit. Capacity causes a displacement of phase between the electromotive force and the current. Is this displacement such as to cause the current to lead before the E.M.F., or to lag behind it?

A complete answer to the question is given by the solutions of the following problem:—An electromotive force, e, $\sin p t$ is generated in a circuit of total resistance, r, containing self-induction, L, and capacity, C; find the current at any instant.

The equation for the current, i, is known to be

$$L\frac{d^2 i}{d t^2} + r\frac{d i}{d t} + \frac{i}{C} = p e \cos p t \qquad (1)$$

The solution of which is:

$$i = \frac{e \sin (p t + \theta)}{\sqrt{\left\{ r^2 + \left(\frac{1}{C p} - p L\right)^2 \right\}}} \qquad (2)$$

where

$$\tan \theta = \frac{\frac{1}{p C} - p L}{r} \qquad (3)$$

Here θ is the displacement of phase between e and i. If there is no condenser in circuit C is infinite, and the phase displacement is given by the equation

$$\tan \theta = -\frac{p L}{r} \qquad (4)$$

In this case it is universally admitted that the current lags behind the E.M.F. by amount which, by equation (4), *cannot exceed* 90 degrees.

If the circuit contains a condenser, but no self-induction, $L = 0$ and the displacement is given by the equation

$$\tan \theta = \frac{1}{p C r} \qquad (5)$$

Now, by supposition, none of the quantities p, C and r are

zero, therefore the value of θ given by (5) is *less* than 90 degrees.

Furthermore, equation (3) shows that when

$$\frac{1}{p\,C} = p\,L \qquad (6)$$

Then $$\tan\theta = 0;$$

that is, the displacement of the current over the E.M.F. is either zero or 180°. The latter value is inadmissible since the displacements due to capacity and self-induction, separately, have been shown to be less than 90°, so that the displacement due to the combination must be less than 180°. The only alternative when (6) is satisfied, is that $\theta = 0$ (or a multiple of $2\,\pi$, which is excluded for a similar reason). Thus, if the effect of self-induction is to cause the current to *lag* behind the E.M.F., then capacity causes the current to *lead* before the E.M.F. which is generated in the circuit.

The physical nature of the phenomena compels us, therefore, to regard a lag or a lead of over 180° as meaningless when the only E.M.Fs. in circuit, in addition to an impressed E.M.F., are due to capacity or self-induction.

Suppose for a moment that both capacity and self-induction produce a lagging current: what interpretation must we give to equation (3) when condition (6) is satisfied? θ would then equal 360° or, if we denote by N_1 and N_2 two successive similar poles of an alternator, the maximum current in the armature due to passing the pole N_1 would coincide with the position corresponding to maximum E.M.F., due to cutting the lines from N_2, which is absurd. If, then, we call the displacement of phase of current over E.M.F., due to self-induction, a lag, we are driven to calling that due to capacity a lead.

CONNECTING INCANDESCENCE LAMPS IN SERIES ON ALTERNATING CURRENTS.*

The connecting in series of incandescence lamps, which has already been put into practice in special cases, is likely to be considerably extended in the future. It is notably justified in installations including a large number of lamps, always lighted simultaneously, and distributed over a long line. It is thus suited to the lighting of streets, canals, &c., its chief advantages consisting in the employment of high tensions, and the consequent saving of copper, and also in the remarkable simplicity and facility of working of the whole system. The production of high tensions from continuous currents involving some difficulty, in cases of this kind recourse is had to alternating currents which lend themselves readily and with complete reliability of working to high tensions as regards both direct production in the machines themselves, and transformation. The employment of alternating currents for the feeding of arc and incandescence lamps in series dates from the earliest years of the modern applications of electricity; but the utilisation of reaction coils has lately imparted fresh interest to the subject in the hands of the Westinghouse Electric Company in America, and in Germany in those of the Helios Company, who have applied it to the lighting of the Baltic Canal. Confining ourselves to the case of incandescence lamps, we shall study co-ordinately with M. Alexandre Rothert†, their connection in series on reaction coils and on little individual transformers.

In the first system, as shown in fig. 1, a reaction coil is connected in derivation on each lamp. In normal working, the feeding current, I, is divided into two branches, one of which, i_1, passes through the lamp, and the other, i_m, through the reaction coil. The latter corresponds to a slight loss of power, the lag between the current and the difference of potential in the coil being about a quarter of a period. This power lost in the derivation corresponds to the hysteresis and the parasitic currents developed in the iron core of this coil, and also to the heating of its winding. It thus amounts to only a small fraction of the total power absorbed by the installation. By assuming, for the sake of simplicity, a difference of phase exactly equal to a quarter of a period, a very slight error is committed, and one that has no influence on the final result.

* By E. B. in *L'Industrie Electrique*.

† *Elektrotechnische Zeitschrift*, March 5th, 1896.

Under these conditions, we can represent by the diagram shown in fig. 2, the currents and tensions in the system considered. Let u be the difference of potential at the terminals of the lamps, *i.e.*, the total difference for the series of N lamps fed, divided by this number, N, of lamps; the incandescence lamps being able, generally speaking, to be considered as deprived of self-induction, the current in them agrees in phase with the difference of potential. Let i_1 be this current in the lamps. The current, i_m, circulating in the reaction coils, should, according to the above reasoning, lag behind by a quarter of a period. These two currents, i_1 and i_m, are thus constituted according to the known parallelogram and their resultant gives the feeding current, I, with a lag of the angle, ϕ, on the difference of potential.

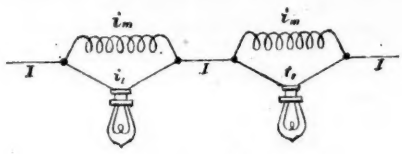


Fig. 1.

From this we see that for the same current, i_1, in the lamps, the difference of phase, ϕ, and also the feeding current, I, will be greater in proportion as the intensity, i_m, in the reaction coils is itself greater. This current in the reaction coils, which may at the same time be regarded as a magnetising current, is consequently in proportion to the reluctance of the magnetic circuit of the reaction coil; we can therefore modify it by introducing, for example, an "entrefer" into the closed magnetic circuit of the bobbin. An increase of intensity in this bobbin would, in the case under consideration, modify the diagram in fig. 2, according to the dotted lines.

We will now consider the diagram corresponding to a lamp extinguished by the destruction of its filament or by

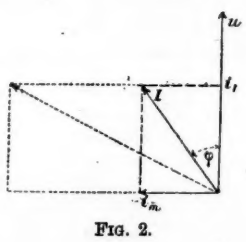


Fig. 2.

some other accident; the total current of the system (provisionally regarded as constant) will then pass through the bobbin without being interrupted. But if we suppose the reluctance to be constant, the difference of potential between the two extremities of a reaction coil is in proportion to the current of which it is the seat; it increases, therefore, and takes as its new value

$$u' = u\,\frac{I}{i_m} \qquad (1)$$

at the same time undergoing a modification of phase, the

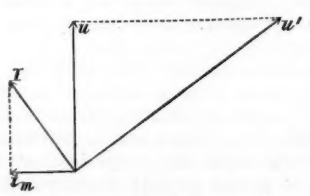


Fig. 3.

latter now being a quarter of a period in advance of the line current, I. Of course, in this case, it is not a question of the difference of potential of self-induction, but of the component of the tension of the system that makes equilibrium with it, whence the *variation in advance* (fig. 3) shows the relation between u' and u as a function of the other mag-

nitudes: i_m and u correspond to the relations in normal working, whereas u' represents the difference of potential at the terminals of a reaction coil when the corresponding lamp is burnt. We can easily see from fig. 3 that u' is to I as u is to i_m; this is what follows from equation (1).

As long as I remains constant, as has been assumed up to now, the other lamps remain quite independent of this modification.

We will now trace the diagram for a complete system of four incandescence lamps, for instance, mounted in series with reaction coils. The differences of potential at the terminals of the lamps should all be reckoned in the same

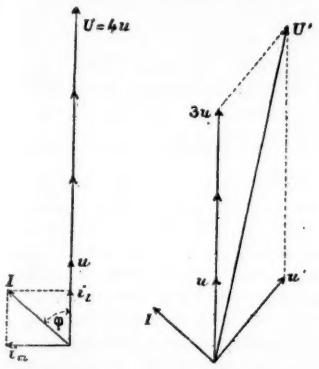


Fig. 4.

Fig. 5.

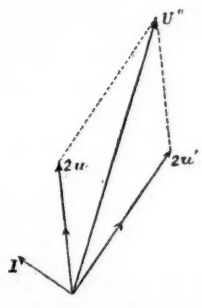


Fig. 6.

direction, and we get for the normal working, U = 4 u (fig. 4). If one of these lamps goes out, all the others burning on unaltered as we have supposed, there now only remains 3 u on the vertical line corresponding to 4 u (fig. 5). This suppression of a lamp brings the diagram to the construction shown in fig. 3. Instead of the normal tension, u, we now get the higher tension, u', and as the difference of phase is no longer the same as for 3 u, the two tensions expressed geometrically, give as their resultant U'. If two lamps should go out, as I is supposed to remain constant, we get in the same way the diagram shown in fig. 6, &c.

In reality, I does not remain quite constant. It is practically much weaker, in order to keep U constant. As we see by figs. 4, 5 and 6, U' is greater than U; if U remains constant, we must, in diagrams 5 and 6, reduce all magnitudes in the ratio of U' to U, and we shall obtain the effective line current and the effective lamp current. The lamps will thus work at an intensity and tension somewhat less than in normal working, if one or more of them should be extinguished. We can, however, practically reduce this weakening of the intensity to as small a quantity as we wish, which enables us to render the system self-regulating under a con-

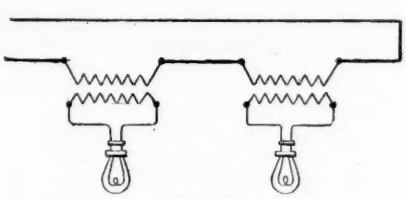


Fig. 7.

stant difference of potential. The more we increase the current in the reaction coils for a given intensity in the lamps, the more we shall reduce the difference between the feeding current and that which passes through its bobbins (fig. 2). The closer the ratio of $\frac{i_m}{I}$ and $\frac{u}{u'}$ approximates to unity, the less difference will there be between u and u', and consequently the better will be the regulation for a given number of lamps extinguished at once. As regards the efficiency of the installation, we must, however, endeavour to have a feeding current with the lowest possible intensity, and on account of the reaction on the generator, a difference of phase also, as small as possible between the line current and the difference of potential; hence the necessity, for the extinction of a given number of lamps, of calculating for the reaction coils the weakest current that can impart to the system the desired self-regulation. We shall presently describe a simple graphic method for the solution of this problem.

The other method of connecting incandescence lamps in series consists in feeding each one by means of the secondary wire of a little transformer, the primary of which is in series with the primaries of similar transformers for all the others.

We see in fig. 7 the plan of this arrangement. In order to study the mode of procedure for normal working, let us first trace the known diagram of the transformer in fig. 8.

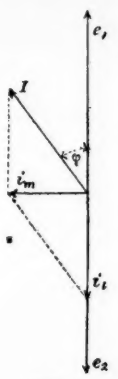


Fig. 8.

Let e_1 be the primary E.M.F. virtually equal to the primary difference of potential at the terminals, u_1.
e_2 the secondary E.M.F. equal to the secondary difference of potential at the terminals, u_2, *i.e.*, that at the terminals of the lamps:
i_1, the secondary current passing through the lamps;
i_m, the magnetising current required for the production of the indispensable C.E.M.F.;
I, the primary current;
ϕ, the difference of phase in the primary system.

In this diagram it is taken for granted that the primary and secondary wires of the transformer contain the same number of turns. If it were not so, we should have to substitute for i_1, i_m, and I, in the diagram, the corresponding ampere-turns, and we should get the correlative currents by dividing these ampere-turns by the respective numbers of turns.

(*To be continued.*)

ON THE MEASUREMENT OF THE INSULATION RESISTANCE OF STREET RAILWAY CABLES.*

By EDWIN J. HOUSTON, Ph.D., and A. E. KENNELLY, Sc.D.

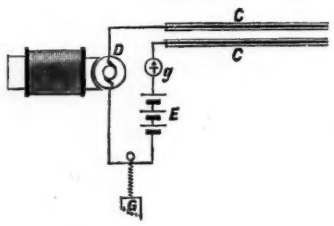
In the street railway systems of large cities it has become necessary to place a number of feeder cables underground. A large amount of capital is necessarily expended in these cables, and their insulation is a matter of considerable importance. It is well known that when such cables are tested at the power house from which they diverge, considerable difficulty is experienced in obtaining reliable observations with the ordinary deflection method of measuring insulation employing a battery and galvanometer. Superposed upon the leakage current passing through the galvanometer in such measures are a series of erratic current oscillations or variations. These may be due either to induction from neighbouring cables, or to the absence of what may be regarded as perfect ground connection. Thus, in fig. 1 the generator, D, represents the working dynamo or dynamos in the power house supplying the working cable or cables C'; the testing battery, E, is grounded at G, either directly to the station ground or to some ground in its

* New York *Electrical World.*

vicinity. There is necessarily some small resistance in the ground connection of the station and the varying load current passing through this resistance establishes a varying small C.E.M.F. or drop of pressure at ground connection, p; the result is that the E.M.F., E, of the testing battery, is virtually varied in conformity with variations of load on the system, and these variations produce disturbances upon the testing galvanometer, g. In some cases these disturbances may be so violent that no reliable test can be obtained while the power house is working. The following method, which is based upon the method of fall of charge, appears to supply a reliable means for determining the insulation of cables under such circumstances:—

In fig. 2, C represents the cable whose insulation is to be measured. c is a small condenser, K is a back-and-front contact-testing key, k a front-contact key, E a testing battery of say 100 silver chloride cells, and g a D'Arsonval galvanometer.

Fig. 1.



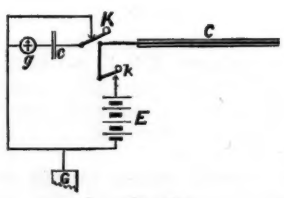


Fig. 2.

The method of operation is as follows:

The cable to be tested, after being insulated at the distant end, is grounded at the power-house for a sufficient length of time to discharge it as thoroughly as possible, so as to get rid of the effects of the charge from the working 500-volt pressure. It is then connected by the key, K, with the condenser, c, which is in its turn grounded through the galvanometer, g. The battery key, k, is then depressed, charging both condenser and cable. The key, K, is then released, and the discharge passed through the galvanometer, g. This gives a deflection representing the full charge of the cable. Since the galvanometer is in permanent connection with the cable through the condenser, a moment may be selected for the release of the key, k, when the current through the galvanometer is zero, indicating a moment when the charge in the cable is steady. The key, K, is then again depressed, and the battery key, k, again charges the system, say for 30 seconds. The battery key is then released and the system is allowed to leak for, say five minutes. At the end of that time, or at any suitable moment shown by the galvanometer, g, the key, K, is lifted from its front contact and discharged through the back contact and through the galvanometer. This deflection will be less than the first deflection by reason of the loss of charge or leakage through the system. The advantage of this method over the ordinary fall of charge method lies in the fact that if the moment for disconnecting the small condenser from the cable be suitably chosen, the charge in the condenser represents the normal charge in the cable at that moment, and the discharge subsequently made through the galvanometer is not liable to any irregularities either from induction or imperfect ground.

In order to determine in megohms the insulation from these observations, it is necessary to know the electrostatic capacity of the cable in microfarads. This can be determined by any of the well-known methods, or it may be obtained in the first instance from the manufacturers when the cable is delivered. It is not, however, essential that the capacity should be known in order to ascertain whether the insulation of the cable is in good condition, since the percentage of loss of charge in a given time, such as five minutes, is a definite criterion of the cable's insulation, and it would be sufficient to record this percentage from month to month without actually computing the insulation except when specially necessary. The loss of charge for a given cable does not depend upon its length, if the insulation be uniform, mechanically and electrically. A five-mile cable of the same material and dimensions will lose a given percentage of its charge by uniform leakage in the same time as a one-mile cable.

The well-known formula for the insulation resistance by loss of charge is

$$\text{R} = \frac{0{\cdot}4343\ t}{\text{C} \log \frac{Q}{q}} \text{ megohms},$$

where R, is the absolute insulation resistance of the cable in megohms, t, the time of insulation or leakage in seconds; C, the electrostatic capacity of the cable in microfarads, and $\frac{Q}{q}$ the ratio of full charge to reduced charge. Since in this case a small condenser is added to the cable, the result has to be corrected, strictly speaking, for both the capacity and the leakage in this condenser. It is, however, preferable to employ a very small condenser, say $\frac{1}{30}$th microfarad. This with a testing E.M.F. of 100 volts should be sufficient to give a good deflection on the galvanometer scale without any shunt. This possesses the advantage of obviating any error due to the use of a shunt with momentary discharges through the galvanometer, and also renders the correction for the capacity of the condenser in most cases negligibly small.

The following example of an actual measurement made in this way will serve to illustrate the method:—

A cable three miles long has an assumed capacity of three microfarads. E = 100 volts, approximately. c = 0·025 microfarad. The full discharge was 211 divisions deflection, and the discharge, after a delay of 300 seconds, was 197 divisions. The insulation resistance was therefore

$$\text{R} = \frac{0{\cdot}4343 \times 300}{3 \times \log \frac{211}{197}} = \frac{0{\cdot}4343 \times 300}{3 \times 0{\cdot}15697} = 276{\cdot}7 \text{ megohms}$$
$$= 830{\cdot}1 \text{ megohm-miles}.$$

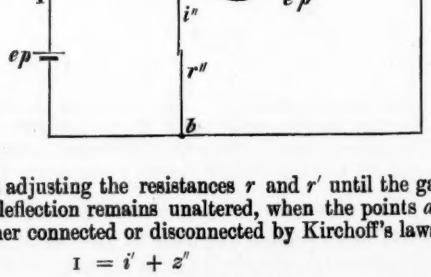
For all ordinary purposes it would be sufficient to observe that the percentage of loss of charge in five minutes was

$$\frac{64}{211} \times 100 = 30{\cdot}33 \text{ per cent.},$$

and this, without any calculation, would serve as a reliable criterion of the cable's insulation, practically independent of all disturbances from induction or imperfect ground.

A METHOD OF COMPARING THE ELECTRO-MOTIVE FORCES OF BATTERIES.

This method, devised by M. D. Negreau, and described in *L'Eclairage Electrique*, is shown by the figure. The test con-



sists in adjusting the resistances r and r' until the galvanometer deflection remains unaltered, when the points a and b are either connected or disconnected by Kirchoff's laws.

$$\text{I} = i' + z''$$
$$e = \text{I}(\rho + r) + i'' r''$$
$$e' = i'(q + \rho'' + r') - i'' r'',$$

r'' being the resistance of the wire connecting a and b.

When the connection of a and b does not alter the galvanometer deviation then $i'' = 0$, so that

$$\text{I} = i'$$
$$e = \text{I}\,(\rho \text{ and } r)$$
$$e' = \text{I}\,(g + \rho' + r').$$

From which

$$\frac{e'}{e} = \frac{g + \rho' + r'}{\rho + r} \qquad \text{(A)}.$$

By making a second test with r and r' augmented by r_1 and r'_1 so that

$$\frac{e'}{e} = \frac{g + \rho' + r' + r'_1}{\rho + r + r_1} \qquad \text{(B)};$$

then by combining A and B we get

$$\frac{e'}{e} = \frac{r'_1}{r_1}$$

COMBINED ALTERNATING AND CONTINUOUS CURRENT DYNAMOS.

By RANKIN KENNEDY.

In a series of articles (Electrical Review, 1893, Vol. xxxii., pages 444 to 661) the great advantages of a combined alternating and continuous current dynamo were set forth, and a double dynamo, capable of running alternating and continuous currents, and also multiphase current if desired, was illustrated and described. It takes years, however, to educate the ordinary engineers engaged in the electricity supply business to learn of any advantages over the common three or five-wire continuous current, or the common alternating high pressure systems; these antiquated methods seem to satisfy their adherents immensely.

The combined system has, however, had a fair trial, although only partially, at Woolwich, with surprisingly satisfactory results, in the way of assisting to level the load line and as a stand-by in emergencies.

The distribution is by alternating current at ordinary pressures, and the transmission is by alternating current at 2,000 volts.

The machine used at Woolwich is simply a continuous current dynamo and an alternator, coupled shaft to shaft; the output of the dynamo is 400 amperes, from 100 to 130 volts, the alternator output being 17·5 amperes at 2,000 volts.

The alternator feeds into the transmission mains, while the dynamo feeds into a storage battery.

Thus the load may be kept full all the time, for all the surplus energy over and above that required for the time being is stored in the battery, which store can then be drawn upon at the time when station load is heavy, and it can, by assisting the engine through the dynamo as a motor, double the output of the alternator at a pinch.

When a sudden demand is made for current they are always ready to respond to it.

This method of operating is the best yet proposed for employing storage in connection with alternating currents, and no doubt, in course of time, it will be more and more used as an auxiliary in alternating supply works.

But the possibilities of combined alternating and continuous machines are far beyond the use of them as mere auxiliaries; to get the full advantages, the system described in the articles alluded to must be carried out in its entirety. All the good points of continuous and alternating currents are thereby secured, and many of the weak points in both eliminated.

There can be not the slightest doubt now that continuous currents on the whole are more serviceable than alternating currents to the average consumer, while on the other hand alternating current is by far the best for high pressure transmission work. That being so, the author advocates the use of combined alternating and continuous current dynamos for central station work, whether for light or power or both.

The common alternating current system has not been able to dispense with the network of low pressure distribution mains, as was fondly hoped it would do in the early days. When that system was introduced, the high pressure was to save immense quantities of copper in distributing electricity. It turns out, however, in practice, that the high pressure saves copper only in the feeders or transmission part of a system, and that we have still the mass of copper to lay down in distributing the energy, and the copper saved in some cases in the transmission system is more than all expended in transformers, &c.; these are facts which are worthy of some attention. Then the continuous current three-wire system has also practically failed to come up to the claims of its originators; it was also to save copper, which no doubt it does, but at what cost? It was an improvement on the old three-wire system, in which the middle wire was not brought back to the junction between the dynamos. This old system, of course, required to have the load on each side fairly balanced when it worked, just as well as the new three-wire system. But what do we hear of in every three-wire station? Nothing but the constant strenuous efforts to preserve a balance, and elaborate apparatus to maintain a balance, and most stringent rules and regulations are issued to customers to prevent them disturbing the balance of load on the two sides of the middle wire. This anxiety about an even balance makes one often doubt whether the third wire has really been connected up; at any rate, the new three-wire system seems to require much nicety of balance, and it does not quite overcome that difficulty in the older series-parallel system.

The introduction of a combined alternating and continuous system is the only remedy for many of the difficulties now met with, difficulties which can only be fully realised by a perusal of some of the interesting little books issued as rules and regulations for electricity supplies, especially those compiled by continuous current engineers.

TRADING DISHONESTY IN JAPAN.

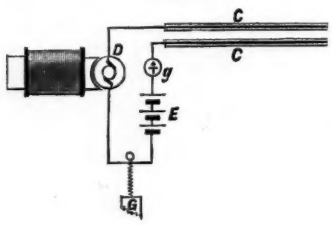
Like young engineers, the Japanese, as a community, seem to be devoid of the power to discriminate imperfections in work. They cannot construe specifications in the spirit, and have condemned heaps of good imports for mere literal departures from specification. They would jib at a small blow hole in a pile driver tup, and reject a whole locomotive for a dint in a tank plate, and European manufacturers are getting to fight shy of their rigid conditions drawn out by pedants, and enforced by students. But the Japanese manufacturers have been more than equal to the Japanese inspectors. It appears that a certain Japanese company made a contract for some 20,000 tons of pipes. They could fulfil neither in time nor quantity, and only about one-fifth of the pipes passed the pressure test. Ingenious to a fault, they did not attempt to remedy the method of casting; but they did both attempt and succeed in so juggling the hydraulic pressure gauge, as to read a pressure of 150 lbs. where there was only 100 lbs. The success of this move encouraged to further flights, and other gauges were similarly tricked to show nearly double pressures.

Then they renumbered rejected pipes and re-marked them, and finally they were found out, and there will be both civil and criminal proceedings, in which even a university professor is to be mixed up—not as scientific expert, however. His scientific expertness was, we judge, exerted in the bye-play with the gauges and similar little pranks. His present position is as one of the defendants. We have numbers of the trading professor amongst us in England, but, so far, we hope they are none of them quite so low down as this, we trust, exceptional Jap. Scientific training seems very often to be diverted into curious channels. A large calico printer recently informed us that the chemical knowledge of the German drug and dyestuff manufacturers seemed to be devoted entirely to the art of defeating tests rather than to the manufacture of drugs to pass genuine muster. It was the Germans who introduced that dangerous adulterant in Portland cement—gypsum, to wit—entirely with a view to circumventing the American tests for cement. It matters not to the Germans that their cement is rendered dangerous, and that better results can be attained by safe means at very trifling cost. They have found an adulterant to serve a merely temporary purpose, and that is all they care to do. The Japanese seem to be following on similar lines. It would be amusing were it not so pitiable.

vicinity. There is necessarily some small resistance in the ground connection of the station and the varying load current passing through this resistance establishes a varying small C.E.M.F. or drop of pressure at ground connection, p; the result is that the E.M.F., E, of the testing battery, is virtually varied in conformity with variations of load on the system, and these variations produce disturbances upon the testing galvanometer, g. In some cases these disturbances may be so violent that no reliable test can be obtained while the power house is working. The following method, which is based upon the method of fall of charge, appears to supply a reliable means for determining the insulation of cables under such circumstances:—

In fig. 2, C represents the cable whose insulation is to be measured. c is a small condenser, K is a back-and-front contact-testing key, k a front-contact key, E a testing battery of say 100 silver chloride cells, and g a D'Arsonval galvanometer.

FIG. 1.



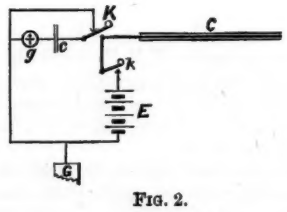


FIG. 2.

The method of operation is as follows:

The cable to be tested, after being insulated at the distant end, is grounded at the power-house for a sufficient length of time to discharge it as thoroughly as possible, so as to get rid of the effects of the charge from the working 500-volt pressure. It is then connected by the key, K, with the condenser, c, which is in its turn grounded through the galvanometer, g. The battery key, k, is then depressed, charging both condenser and cable. The key, K, is then released, and the discharge passed through the galvanometer, g. This gives a deflection representing the full charge of the cable. Since the galvanometer is in permanent connection with the cable through the condenser, a moment may be selected for the release of the key, k, when the current through the galvanometer is zero, indicating a moment when the charge in the cable is steady. The key, K, is then again depressed, and the battery key, k, again charges the system, say for 30 seconds. The battery key is then released and the system is allowed to leak for, say five minutes. At the end of that time, or at any suitable moment shown by the galvanometer, g, the key, K, is lifted from its front contact and discharged through the back contact and through the galvanometer. This deflection will be less than the first deflection by reason of the loss of charge or leakage through the system. The advantage of this method over the ordinary fall of charge method lies in the fact that if the moment for disconnecting the small condenser from the cable be suitably chosen, the charge in the condenser represents the normal charge in the cable at that moment, and the discharge subsequently made through the galvanometer is not liable to any irregularities either from induction or imperfect ground.

In order to determine in megohms the insulation from these observations, it is necessary to know the electrostatic capacity of the cable in microfarads. This can be determined by any of the well-known methods, or it may be obtained in the first instance from the manufacturers when the cable is delivered. It is not, however, essential that the capacity should be known in order to ascertain whether the insulation of the cable is in good condition, since the percentage of loss of charge in a given time, such as five minutes, is a definite criterion of the cable's insulation, and it would be sufficient to record this percentage from month to month without actually computing the insulation except when specially necessary. The loss of charge for a given cable does not depend upon its length, if the insulation be uniform, mechanically and electrically. A five-mile cable of the same material and dimensions will lose a given percentage of its charge by uniform leakage in the same time as a one-mile cable.

The well-known formula for the insulation resistance by loss of charge is

$$\text{R} = \frac{0{\cdot}4343\ t}{\text{C} \log \frac{\text{Q}}{q}} \text{ megohms},$$

where R, is the absolute insulation resistance of the cable in megohms, t, the time of insulation or leakage in seconds; C, the electrostatic capacity of the cable in microfarads, and $\frac{\text{Q}}{q}$ the ratio of full charge to reduced charge. Since in this case a small condenser is added to the cable, the result has to be corrected, strictly speaking, for both the capacity and the leakage in this condenser. It is, however, preferable to employ a very small condenser, say $\frac{1}{500}$th microfarad. This with a testing E.M.F. of 100 volts should be sufficient to give a good deflection on the galvanometer scale without any shunt. This possesses the advantage of obviating any error due to the use of a shunt with momentary discharges through the galvanometer, and also renders the correction for the capacity of the condenser in most cases negligibly small.

The following example of an actual measurement made in this way will serve to illustrate the method:—

A cable three miles long has an assumed capacity of three microfarads. E = 100 volts, approximately. c = 0·025 microfarad. The full discharge was 211 divisions deflection, and the discharge, after a delay of 300 seconds, was 197 divisions. The insulation resistance was therefore

$$\text{R} = \frac{0{\cdot}4343 \times 300}{3 \times \log \frac{211}{197}} = \frac{0{\cdot}4343 \times 300}{3 \times 0{\cdot}15697} = 276{\cdot}7 \text{ megohms}$$
$$= 830{\cdot}1 \text{ megohm-miles}.$$

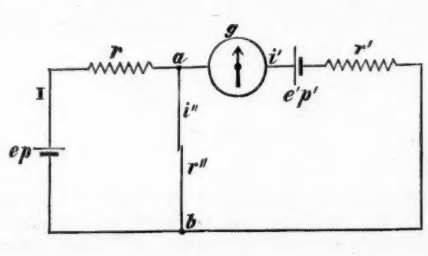
For all ordinary purposes it would be sufficient to observe that the percentage of loss of charge in five minutes was

$$\frac{64}{211} \times 100 = 30{\cdot}33 \text{ per cent.},$$

and this, without any calculation, would serve as a reliable criterion of the cable's insulation, practically independent of all disturbances from induction or imperfect ground.

A METHOD OF COMPARING THE ELECTRO-MOTIVE FORCES OF BATTERIES.

THIS method, devised by M. D. Negreau, and described in *L'Eclairage Electrique*, is shown by the figure. The test con-



sists in adjusting the resistances r and r' until the galvanometer deflection remains unaltered, when the points a and b are either connected or disconnected by Kirchoff's laws.

$$\text{I} = i' + z''$$
$$e = \text{I}(\rho + r) + i'' r''$$
$$e' = i'(q + \rho'' + r') - i'' r'',$$

r'' being the resistance of the wire connecting a and b.

When the connection of a and b does not alter the galvanometer deviation then $i'' = 0$, so that

$$\begin{aligned} \text{I} &= i' \\ e &= \text{I}\ (\rho \text{ and } r) \\ e' &= \text{I}\ (g + \rho' + r'). \end{aligned}$$

From which

$$\frac{e'}{e} = \frac{g + \rho' + r'}{\rho + r} \qquad \text{(A)}.$$

By making a second test with r and r' augmented by r_1 and r'_1 so that

$$\frac{e'}{e} = \frac{g + \rho' + r' + r'_1}{\rho + r + r_1} \qquad \text{(B)};$$

then by combining A and B we get

$$\frac{e'}{e} = \frac{r'_1}{r_1}$$

COMBINED ALTERNATING AND CONTINUOUS CURRENT DYNAMOS.

By RANKIN KENNEDY.

In a series of articles (Electrical Review, 1893, Vol. xxxii., pages 444 to 661) the great advantages of a combined alternating and continuous current dynamo were set forth, and a double dynamo, capable of running alternating and continuous currents, and also multiphase current if desired, was illustrated and described. It takes years, however, to educate the ordinary engineers engaged in the electricity supply business to learn of any advantages over the common three or five-wire continuous current, or the common alternating high pressure systems; these antiquated methods seem to satisfy their adherents immensely.

The combined system has, however, had a fair trial, although only partially, at Woolwich, with surprisingly satisfactory results, in the way of assisting to level the load line and as a stand-by in emergencies.

The distribution is by alternating current at ordinary pressures, and the transmission is by alternating current at 2,000 volts.

The machine used at Woolwich is simply a continuous current dynamo and an alternator, coupled shaft to shaft; the output of the dynamo is 400 amperes, from 100 to 130 volts, the alternator output being 17·5 amperes at 2,000 volts.

The alternator feeds into the transmission mains, while the dynamo feeds into a storage battery.

Thus the load may be kept full all the time, for all the surplus energy over and above that required for the time being is stored in the battery, which store can then be drawn upon at the time when station load is heavy, and it can, by assisting the engine through the dynamo as a motor, double the output of the alternator at a pinch.

When a sudden demand is made for current they are always ready to respond to it.

This method of operating is the best yet proposed for employing storage in connection with alternating currents, and no doubt, in course of time, it will be more and more used as an auxiliary in alternating supply works.

But the possibilities of combined alternating and continuous machines are far beyond the use of them as mere auxiliaries; to get the full advantages, the system described in the articles alluded to must be carried out in its entirety. All the good points of continuous and alternating currents are thereby secured, and many of the weak points in both eliminated.

There can be not the slightest doubt now that continuous currents on the whole are more serviceable than alternating currents to the average consumer, while on the other hand alternating current is by far the best for high pressure transmission work. That being so, the author advocates the use of combined alternating and continuous current dynamos for central station work, whether for light or power or both.

The common alternating current system has not been able to dispense with the network of low pressure distribution mains, as was fondly hoped it would do in the early days. When that system was introduced, the high pressure was to save immense quantities of copper in distributing electricity. It turns out, however, in practice, that the high pressure saves copper only in the feeders or transmission part of a system, and that we have still the mass of copper to lay down in distributing the energy, and the copper saved in some cases in the transmission system is more than all expended in transformers, &c.; these are facts which are worthy of some attention. Then the continuous current three-wire system has also practically failed to come up to the claims of its originators; it was also to save copper, which no doubt it does, but at what cost? It was an improvement on the old three-wire system, in which the middle wire was not brought back to the junction between the dynamos. This old system, of course, required to have the load on each side fairly balanced when it worked, just as well as the new three-wire system. But what do we hear of in every three-wire station? Nothing but the constant strenuous efforts to preserve a balance, and elaborate apparatus to maintain a balance, and most stringent rules and regulations are issued to customers to prevent them disturbing the balance of load on the two sides of the middle wire. This anxiety about an even balance makes one often doubt whether the third wire has really been connected up; at any rate, the new three-wire system seems to require much nicety of balance, and it does not quite overcome that difficulty in the older series-parallel system.

The introduction of a combined alternating and continuous system is the only remedy for many of the difficulties now met with, difficulties which can only be fully realised by a perusal of some of the interesting little books issued as rules and regulations for electricity supplies, especially those compiled by continuous current engineers.

TRADING DISHONESTY IN JAPAN.

Like young engineers, the Japanese, as a community, seem to be devoid of the power to discriminate imperfections in work. They cannot construe specifications in the spirit, and have condemned heaps of good imports for mere literal departures from specification. They would jib at a small blow hole in a pile driver tup, and reject a whole locomotive for a dint in a tank plate, and European manufacturers are getting to fight shy of their rigid conditions drawn out by pedants, and enforced by students. But the Japanese manufacturers have been more than equal to the Japanese inspectors. It appears that a certain Japanese company made a contract for some 20,000 tons of pipes. They could fulfil neither in time nor quantity, and only about one-fifth of the pipes passed the pressure test. Ingenious to a fault, they did not attempt to remedy the method of casting; but they did both attempt and succeed in so juggling the hydraulic pressure gauge, as to read a pressure of 150 lbs. where there was only 100 lbs. The success of this move encouraged to further flights, and other gauges were similarly tricked to show nearly double pressures.

Then they renumbered rejected pipes and re-marked them, and finally they were found out, and there will be both civil and criminal proceedings, in which even a university professor is to be mixed up—not as scientific expert, however. His scientific expertness was, we judge, exerted in the bye-play with the gauges and similar little pranks. His present position is as one of the defendants. We have numbers of the trading professor amongst us in England, but, so far, we hope they are none of them quite so low down as this, we trust, exceptional Jap. Scientific training seems very often to be diverted into curious channels. A large calico printer recently informed us that the chemical knowledge of the German drug and dyestuff manufacturers seemed to be devoted entirely to the art of defeating tests rather than to the manufacture of drugs to pass genuine muster. It was the Germans who introduced that dangerous adulterant in Portland cement—gypsum, to wit—entirely with a view to circumventing the American tests for cement. It matters not to the Germans that their cement is rendered dangerous, and that better results can be attained by safe means at very trifling cost. They have found an adulterant to serve a merely temporary purpose, and that is all they care to do. The Japanese seem to be following on similar lines. It would be amusing were it not so pitiable.

D

TRANSMISSION OF POWER IN MINES.

By RANKIN KENNEDY.

III.

In considering compressed air, we assumed that the latest and best forms of air compressors, pipe lines and air motors were employed, and thereby arrived at the very high efficiency claimed for air; similarly we must assume the use of the best dynamos, engines and motors to secure the best results in electricity.

Mining engineers, as a rule, are quite able to pass judgment on engines, compressors, pipe lines and air motors; but not many of them are able to see the good or bad points in electrical machinery. It may therefore be as well to consider the machinery for electrical transmission rather more closely from an elementary point of view.

Dynamos are supposed to be designed, all of them, upon the rules and formulæ laid down in books and schools, and it might be therefore argued that, made by equally reputable firms, one machine is as good as another; but that is a great mistake. Mr. G. Kapp, who may be accepted as an authority, has said that the designing of dynamos is a compromise all through, and that is so. The large and wealthy firms who can afford the services of experienced designers are no doubt most likely to produce the best machines, hence we refer to the practice of these designers in selecting the points of good machinery.

Cheap machinery is made and sold perhaps more plentifully than the high class kind, owing to the fierce competition in dynamo-electric machine business; but still the makers of the better class of machines seem to make most profits after all, and their customers are better pleased.

The generators for mining work must give an electric pressure of at least 300 volts, and as high as 700 volts; this higher pressure is not to be recommended, for contact with it is probably fatal; 300 volts is not fatal, except in some few cases, of exceptional constitutional weakness, and most persons could stand contact with 500 volts and recover. It is entirely a question of current, and current is equal to $\frac{E}{R} = C$. Now different people present different R, hence what pressure may be fatal to one man, is safe with another. At any rate, if more than 300 volts is used, very careful insulation and wiring must be employed.

Generators may be classed into three types: No. 1, single bobbin; No. 2, bipolar; No. 3, multipolar, figs. 1, 2, 3, 4.

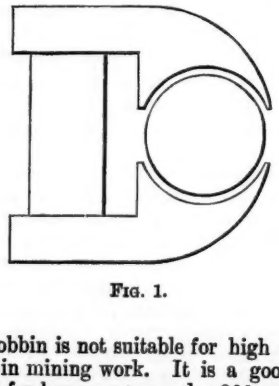


Fig. 1.

The single bobbin is not suitable for high pressures, such as are required in mining work. It is a good machine for small sizes, and for low pressure under 200 volts, is a cheap machine to construct.

The bipolar is better up to 300 volts, above which the multipolar is the best machine; in fact, except for small machines under 3 or 4 horse-power, it is best for all higher pressure work: it accommodates the Gramme ring winding very nicely, and that is the safest wind for mining and other rough work. The author recommends hole wound Gramme rings for all mining motors and generators.

The field magnets of all generators should be of cast steel of best quality, or of wrought-iron. Cast-iron machines are worthless; the multipolar No. 3 can be cast of either iron or steel, but if of cast-iron will be more than twice the weight, take up more space and have a lower efficiency, so that no machines, motor, or generator, where economy and efficiency are desired, should have cast-iron field magnets. The same remarks apply to all field magnets; steel making has now reached such perfection that it can be used throughout.

Bipolar magnets can be forged of iron, and are usually so made with, however, in some cases, a cast-iron yoke. This yoke, in many machines, is a weak spot; it should have rather more than double the cross sectional area than the limb of the magnet, while in most cases it is no more than equal, and in some, actually less, in area. It is a very good type of magnet when skilfully applied and designed, and is,

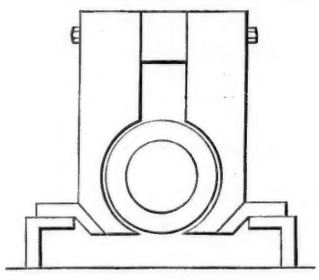


Fig. 2.

perhaps, more used than any other form; though it is not very clear why, except that it is cheaper to make; but in the great majority of cases it is badly designed and worse constructed.

If bipolar machines are adopted, they should be of the undertype, that is, have the armature underneath and magnet above, in which case a wrought-iron yoke will be used, and the one-sided pull of the magnets (which is a common characteristic of both single bobbin and bipolar magnets), can be utilised to some extent in lifting the weight of the armature from the bearings. Moreover, this undertype has a lower-shaft centre, and therefore requires less foundation fixing. It is safe of the two bipolar forms to choose the undertype, but more money must be paid for it.

But the multipolar has advantages over both, especially for larger powers. There is no side pull whatever; it has a perfect balance; the magnets, of good cast-steel, can be made easily for Gramme ring use, with large diameter of armature; the single bobbin and bipolar are more easily adapted to drum armatures of long length and small diameter.

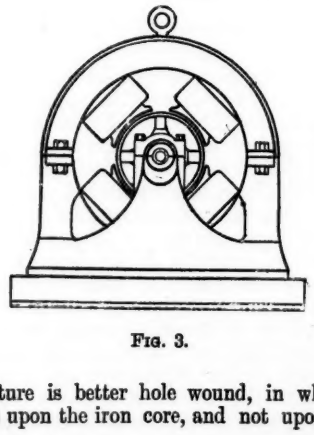


Fig. 3.

The armature is better hole wound, in which case the torque comes upon the iron core, and not upon the copper wire.

The commutator is a very important part of the machine, and is in most cases far too small, especially in cheap machines. The commutator ought to have many sections, be large in diameter, and the sectional area of the blades ought to be sufficient to carry the current even when the commutator is nearly worn out.

The brush holders and brushes are not of much importance if the magnet, the armature and the commutators are right; the simpler they are the better, and the pressure which the brushes have on the commutator should be regulated simply by a spring and screw. If the dynamo is of proper design, the position of the brushes should be fixed on the commutator at all normal loads without sparking. No

cheap dynamo can do this, for every change of load the brushes require adjustment to prevent sparking in cheap machines. Compound wound dynamos are best for power purposes. Here, again, the use of wrought-iron or soft steel magnets is a great advantage; for if a machine is to compound properly, the magnets must be worked considerably below saturation at no load, and not reach saturation at full load; to meet this demand cast-iron requires to be of enormous bulk, and even then its greater hysteresis interferes with compounding.

On all these points of importance the colliery manager or engineer would be well advised to consult an independent electrical engineer when purchasing his generating plant.

All these remarks apply to continuous current motors. Mine motors ought to be enclosed or ironclad. Here, again, the type shown in No. 3 has the advantage of being easily enclosed, whether two-polar or multipolar. Motors which show any tendency to spark under any normal loads, and which require shifting brushes, should not be used at all; they can be made and had to fulfil these conditions; it is only a matter of careful design, and a little extra first cost; 10 per cent. more spent on the motors will, in some instances, reduce the maintenance from 2½ per cent. to 1 per cent., or even less per annum.

Now as to alternating current plants, two-phase or three-phase generators are required; whichever is used the construction is the same, they differ only in winding of the armature.

An example of a good type of polyphase generator would be on the same principle as the continuous generator, No. 3, only having more poles. It produces polyphase currents, preferably of moderately low frequency, 40, or even

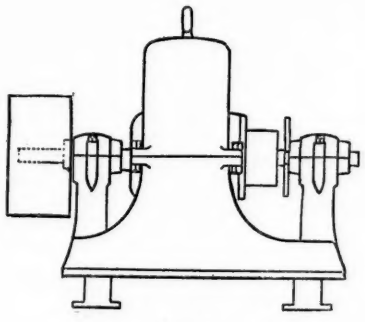


Fig. 4.

as low as 30 ~ per second. In a machine of this type, the frequency per revolution is equal to the number of pairs of poles, so that with six poles we get 3 ~ per second with 10 = 5 ~ per second. To get a fixed frequency, we must have a fixed speed, so that to obtain 30 ~ per second, we would require to run at 10 revolutions if we had six poles, and six revolutions if we had 10 poles on the magnet; in fixing the number of poles these facts must be borne in mind.

Now let us consider the question of speed of driving electric generators. Some years ago an insane demand for slow speed machines set in, and it is still rampant in some quarters, despite the fact that in both continuous and alternating plants high speed generators have invariably proved by far the better machines, and it is not difficult to account for their superiority.

Speed costs the manufacturer of the machine nothing, so that in the higher speed machine better design and materials can be used, for he requires less material as the speed is allowed to go up.

The speed of machines is not measured by number of turns per second, but by peripheral speed of armature in feet per second.

Now, a good hole-wound armature of a Gramme type will run with absolute safety at 7,500 feet per minute; that is, a 20-inch diameter armature might be run at 1,500 revolutions per minute; but to make sure of a large margin, we fix the peripheral speed at 3,500, giving 700 revolutions per minute, as a slow speed for this size of armature.

If a lower speed is desired than 700, then the armature ought to be enlarged in diameter in proportion to keep the peripheral speed the same.

Alternators may run higher than continuous machines, for to keep down self induction and armature reactions speed is the best factor to increase. Some of the best machines run as high as 8,000 feet per minute.

The best machines have the highest speed and the most powerful field magnet; thus, if we take a machine running at 500 revolutions per minute, with all the faults in it known to dynamos, heating, sparking, wearing at brushes, and so on, and rewind the armature for a speed of 1,000, keeping the field and volts the same, the whole of the troubles will disappear.

There never was any reason given for slow speed being preferred, nor any reasons given against high speed, which would stand the slightest investigation.

For large powers, the fly-wheel alternator is, perhaps, the best; here we have few revolutions with high peripheral speed; in the best of these machines all the poles are excited by one coil wound on the rim of the wheel of the driving engine, and the armature coils are fixed on an outer ring of laminated blocks.

We cannot with electric generators get the same advantages as with air wherein storage is used; hence, in electric power distribution, the generators must often run much under load, and the load will vary considerably. A coupled engine and dynamo has given an efficiency of 85 per cent. to 83 per cent. on a test at full load, that is, 100 I.H.P. has given 83 electric H.P. at the terminals of the dynamo; but with varying load that would drop possibly to an average efficiency of 72 per cent., which is still a little above the efficiency of the best air plants, and 40 per cent. above the common air plants mostly in use at present.

REVIEWS.

Nos. 123-124, *Journal of the Institution of Electrical Engineers.* London: E. & F. N. Spon, 125, Strand.

The contents of these numbers are as follows:—No. 123: Discussion on Mr. Dane Sinclair's paper on "Telephone Exchanges and their Working"; on "Railway Telegraphs, with special reference to recent improvements," by W. Langdon. No. 124: "Experimental Tests on the Influence of the Shape of the Applied Potential Difference Wave on the Iron Losses of Transformers," by Stanley Beeton, C. Percy Taylor, and J. M. Barr; "The Utilisation of Water Power, especially with a Small Fall, with some examples of Plants for the Generation of Electrical Energy," by Alph. Steiger.

The Engineering Index, Vol. II. 1892-1895. Edited by J. B. Johnson, C.E. New York: Published by the *Engineering Magazine.*

This most useful volume is a concise index of over 60 periodicals, both Foreign and American, containing engineering matter. Each subject indexed has a very brief summary showing the scope of the same. Great care appears to have been taken in the compilation, with the result that a most valuable volume has been produced, which, although perhaps rather more useful to our American friends—seeing that American publications naturally come in for the largest share of attention—than to our own engineers, is nevertheless a book which a very large number will appreciate.

The Universal Directory of Railway Officials, 1896.

The 1896 issue of this directory has just been published. It is compiled from official sources by Mr. S. Richardson Blundstone, editor of the *Railway Engineer*, and published by the Directory Publishing Company, Limited. The advantage of having, in so compact a form, a list of railway men in all parts of the world, needs no emphasis from us to commend it. We venture to hope that the events of the next few years in electric traction will so affect railway matters as to alter this directory somewhat considerably, so that it shall contain the names of a larger number of electrical men, who will then be classed under that very comprehensive title "Railway Officials."

BOOKS RECEIVED.

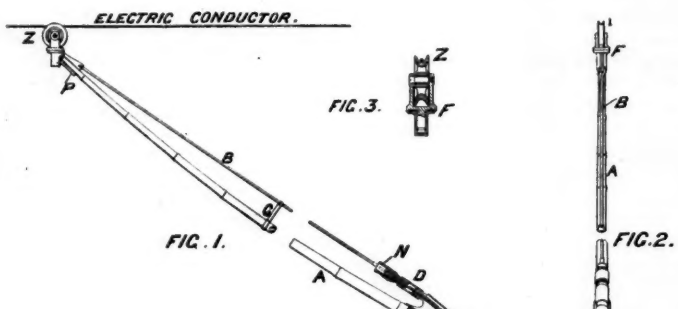
The Glasgow and West of Scotland Technical College Calendar, 1896-1897.

The City and Guilds of London Institute. *Programme of Technological Examinations*; Session 1896-1897.

SCOTT'S BAMBOO TROLLEY MAST.

Owing to the objections to the overhead span wires and pull-over wires as employed on the American system of electric traction, and in the absence of any really satisfactory and cheap conduit, the long swivelling side trolley pole or mast, as used on the South Staffordshire, the Bristol and the Hartlepool tramways, is likely to be extensively adopted in this country. In the American system where the electric conductor or trolley wire follows exactly the curvature of the track, the trolley mast may be fairly short, but with the swivelling side trolley arrangement the mast requires to be long in order that it may easily bridge across the ever varying horizontal and vertical space between the electric conductor and the car.

The weight of the mast and its attachments is an important matter in any case; but in the case of the swivelling side trolley mast especially (which may be as much as 18 feet long), this question of weight is a very serious one, and efforts have therefore to be made to keep everything as light as possible. Something may be gained by making the trolley wheel carrier, and the boss of the wheel, the pivot, &c., of an aluminium alloy; but the major portion of the weight comes from the mast itself, which is generally made of steel.



Scott's Bamboo Trolley Mast.

Theoretically the pole should taper gradually from the heel to the point, but this, of course, is impossible with *drawn* steel tubing, and if, therefore, this material is used it is necessary to have several joints which, whilst being a source of weakness, add to the weight. Another method is to bend a mild steel sheet into the form of a tube and either rivet or weld the joint running from end to end.

There is, however, no reason why steel should be exclusively employed. Bamboo is a material which fits the case in several ways. 1st. It is extremely light, being probably the lightest material of any compared with its strength. 2nd. It is exceedingly cheap and durable. 3rd. It grows in its natural state to the right size and taper and can be got almost any length. 4th. It is a good insulator for the potentials generally used in tramway work. There are two objections to its being used just as it grows. In the first place its great flexibility allows it to bend too much, and under a continued stress in one direction it will gradually alter its shape. The other objection is the one common to all bamboo and metal frameworks, namely the difficulty of making a good connection between the wooden bamboo and its metal end fittings. Whilst bamboos make excellent struts in their natural state they require a separate arrangement to resist pull stresses of any magnitude.

The bamboo trolley mast to be described, has been devised by Mr. Ernest K. Scott, of Wolverhampton, and is one in which it is claimed that the above defects are got rid of. As will be seen from fig. 1, the mast is in reality a compound one consisting of the bamboo, A, and a thin tie rod, B, connected together at their ends, and also about midway in their length by the short tie, C. The bamboo is given a permanent set or bend as shown, and the tension rod is fitted with the right and left hand screw, D. When in its working position the tension rod, B, is uppermost, and thus the pull stress due to the trolley wheel, Z, being pressed upwards against the conductor is taken by this rod, the bamboo merely acting as a strut. It will be also seen that by means of this rod the metal end fittings, P and Q, are kept rigidly in position, and it has still another function, inasmuch as it serves to convey the current from the trolley wheel to the cable which passes down inside the piliar, J. A tube and washer of ebonite in the union, N, serves to insulate the rod from the pillar; the whole forming a very neat, and, at the same time, safer arrangement.

The ends of the bamboo are filled in with cement, as shown cross hatched at E, and the end fittings are so constructed that they will clamp firmly on to varying diameters. So long as the outside skin of a bamboo remains untouched its strength is most remarkable, and from tests which have been made it would appear that, weight for weight, it is thirteen to fourteen times as strong as steel, the steel taken for comparison being that commonly used in solid drawn tubing, which, as is well known, is exceptionally strong. The strength of a bamboo varies according to the distance the nodes are apart, the more nodes there are the stronger it is. It might be thought that the electric current could, with advantage, be carried through the centre of the bamboo, but this is not so, because cutting through the nodes to make room for a conductor would weaken it considerably. A 16 feet bamboo mast of this design could be made (with as long a life, and quite strong enough for its work) which would weigh only about a fifth of the weight of a steel mast of the usual form and the same length.

One of the great advantages of a light weight, and yet elegant mast, such as the one just described, is that it may be made much longer than those at present in use. In towns where the lines are already laid down, the distance from the curb to the rails is sometimes (in wide streets and at corners) very great; so that in replacing steam or horse traction with the overhead system, it is necessary either to have the trolley wire overhanging the roadway by a considerable amount, or else to lengthen the trolley mast. On the South Staffordshire line, for example, in certain places the wire is carried on brackets which project over the roadway as much as ten feet, but what is admissible on a line running for a good part of its distance along open roads, would be objectionable in the busy and built in streets of a large city like Leeds or Birmingham.

A reduction in the weight of the mast is also beneficial, in that it reduces the stresses on the roof of the car where the pillar is attached, and the springs need not be so powerful. In most trolley masts it is usual to apply the vertical upward pressure of the trolley wheel by means of a nest of spiral springs applied at the heel of the mast, and, in swinging round, these springs and their attachments take up much

room, whilst, unless enclosed, there is a danger of passengers getting their fingers caught. In this design the spiral springs are dispensed with, and their place taken by the two simple laminated springs, G, G. It will be noticed that the relative positions of the springs to the mast are such as to give a maximum movement to the trolley wheel with a small movement of the spring, the upward pressure of the wheel being also such as to be approximately equal for different positions of the mast. A small roller, H, allows of ready movement to suit the varying heights of the conductor from the road.

Another detail which differs from existing practice is shown in fig. 3. It will be noticed that the carrier for the trolley wheel is supported on a simple ball bearing, which thus allows it to accommodate itself at once to the varying radii swept out by the mast. There is thus absolutely no liability to jump the wire or the points, and an absence of the sparking sometimes seen when the wheel is not running true with the wire.

THE CALCULATION OF THE CONDUCTIVITY OF MIXTURES OF ELECTROLYTES.

Arrhenius has deduced, as one of the consequences of the dissociation theory of electrolytic conduction, that the condition which must be fulfilled in order that two solutions of single electrolytes which have one ion in common, and which undergo no change of volume on being mixed, may be isohydric, *i.e.*, may, on being mixed, undergo no change in their state of dissociation, is, that the concentration of the ions, that is to say the number of dissociated molecules per unit of volume, shall be the same for both. He obtained this result by combining the equations of kinetic equilibrium for the constituent electrolytes before and after mixture.

This result was subjected by Arrhenius to a number of tests which, though well devised, did not yield satisfactory issues. The lack of agreement which characterised them may have been due to various causes, *e.g.*, the data may have been defective, the change of volume, on mixing, may have been too great for the application of Arrhenius's deduction, and so forth.

On the other hand, Arrhenius has calculated (*vide Wiedemann's Annalen*, xxx., p. 73), the conductivity of two dilute solutions containing in each case given quantities of two acids, employing for this purpose a series of approximations based on his own observations of isohydric solutions of the acids and the calculated values were found to agree with those observed to within 0·5 and 0·2 per cent. respectively. So far as result is concerned, this forms a much more satisfactory test than those mentioned above; but the number of calculations is too small to exclude the possibility of accidental agreement.

The calculation of the conductivity of a mixture of electrolytes is so severe a test of the ionisation theory of electrolysis, that Prof. J. G. Macgregor has thought it desirable to try its possibility on a larger scale, especially as a considerable body of material is now available in the observations of the conductivity of mixtures of potassium and sodium chlorides made by Bender (*vide Wiedemann's Annalen*, xxii., p. 197). In the *Transactions* of the Nova Scotian Institute of Science, Vol. ix., session 1895-96, p. 101, Prof. Macgregor gives the results of these calculations.

The method of calculation and the calculations themselves are scarcely suitable for these pages. From these it is manifest that for solutions of sodium and potassium chlorides containing less than, say, two gramme-molecules per litre, it is possible to calculate the conductivity very exactly, but that for stronger solutions the calculated value is always less than the observed.

The excess of the observed over the calculated conductivities shows one or more of the assumptions implied in the mode of calculation to be erroneous. It would seem to be probable that the error is at any rate largely due to the assumption that the molecular conductivity of an electrolyte at infinite dilution is the same, whether it exists in a simple solution or in a mixture, and that the discrepancy is thus due to the effect of mixing on the velocities of the ions. The mode of calculation assumes that in the mixture the constituents are not really mixed, but lie side by side, so that the ions of each electrolyte in their passage from electrode to electrode, travel through the solution to which they belong only. They must rather be regarded, however, as passing in rapid alternation, now through a region occupied by one solution, and now through a region occupied by the other. The actual mean velocities of the ions in the mixture will therefore probably differ from their values in a solution of their own electrolyte only. In the case of dilute solutions, the difference will be small, in sufficiently dilute solutions, inappreciable; but in the case of stronger solutions it may account in large part for the discrepancy observed above. We have, however, no data for calculating the effect of mixtures on the ionic velocities, or the extent to which the discrepancy is due to this effect.

To obtain some rough conception of its magnitude, Professor Macgregor calculated the conductivity of a mixture in which there were 3·0 gramme molecules of Na Cl and 3·0 of K Cl, on two assumptions which seemed more or less probable, viz., (1) That the velocities of the ions of each electrolyte in the mixture are the same as they would be in a simple solution of their own electrolyte of a concentration (in gramme-molecules per litre), equal to the mean concentration of the mixture, and (2) That the velocities of the ions of each electrolyte, when passing through a region occupied by the other electrolyte, are the same as they would be in a simple solution of the former, of a dilution equal to that of the latter. He found that, according to assumption, (1) the conductivity would be greater than Bender's reduced value by 1·6 per cent., and that, according to assumption, (2) it would be greater by 1·3 per cent.

If the assumptions be regarded as representing even roughly the effect of mixing on the ionic velocities, the calculations based on them show that the error introduced by neglecting the effect of mixing would be of the same sign and order of magnitude as the differences between the calculated and observed values of Kohlrausch's table of ionic velocities. While, therefore, such calculations are of little value, they strengthen the suspicion that the discrepancies of the above table are due to the impossibility of taking into account the effect of mixing on the velocities of the ions.

In the *Transactions* of the Nova Scotian Institute of Science, Vol. ix., page 101, there is a further paper on this subject by Douglas McIntosh. It appears that Prof. McGregor suggested to him, as a corollary to his own work, an investigation to be made with the object of determining (1) What the differences between the observed and calculated values are, in the case of mixtures of sodium and potassium chloride solutions, of greater strength than those examined by Bender, and (2) How the calculated and observed values are related, in the case of solutions containing sodium chloride and hydrochloric acid electrolytes, whose ionic velocities differ from one another much more than those of sodium and potassium chlorides.

The expression for the conductivity of a mixture of equal volumes of solutions of two electrolytes, 1 and 2, which contain n_1 and n_2 gramme equivalents per unit of volume respectively, the ionisation coefficients of which, in the mixture, are a_1 and a_2, the molecular conductivities of which at infinite dilution are $\mu_{\infty 1}$ and $\mu_{\infty 2}$, and which so change in volume on mixing that the ratio of the volume of the mixture to the sum of the volumes of the constituent solutions is p, is

$$C = \frac{1}{2\,p}\,(a_1\,n_1\,\mu_{\infty 1} + a_2\,n_2\,\mu_{\infty 2}).$$

In order to calculate the conductivity of such a mixture, therefore, the seven quantities in this expression must be known. The ionisation coefficients, a_1 and a_2, are determined by the graphical process referred to above, from a series of observations of the conductivities of simple solutions of the constituent electrolytes. The conductivities at infinite dilution are determined by similar observations with very dilute solutions. The concentrations may be determined by analysis, and the quantity, p, by density measurements.

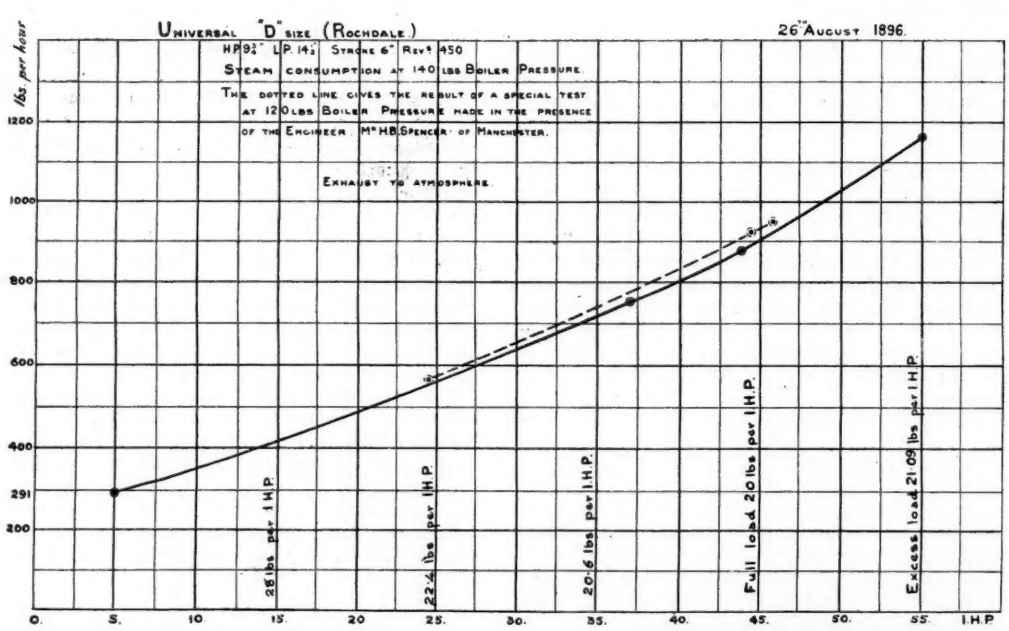
It was intended at the outset to determine all these quantities, in order that the date of calculation might apply to exactly the same electrolytes. But owing to the fact that the electrolytic cell to be used in the determination of conducti-

vities at infinite dilution, although ordered months ago, did not arrive in time, it was necessary to use Kohlrausch's values of the conductivities at infinite dilution for the electrolytes examined.

We shall not follow McIntosh through the details of his work; for these our readers must consult the original paper. We are chiefly concerned with his results, and from the tables given it is seen that in the series of weakest solutions the differences between calculated and observed values are of such small magnitude, and show such alternation of sign as to warrant the conclusion that they are due chiefly to accidental errors. In the two series of stronger solutions the differences are more irregular in magnitude, and the alternation of sign is much less marked, the most of the difference being positive. The results, therefore seem to show that even in the case of two electrolytes with a common ion, which differ so markedly in ionic velocity from one another as sodium chloride and hydrochloric acid, the dissociation theory enables us to calculate the conductivity of solutions containing both, within the limits of experimental error, up to a mean concentration of about 1 gramme-molecule per litre, and that in the case of solutions of greater mean concentration, the calculated value is greater than the observed.

RAWORTH'S HIGH-SPEED "UNIVERSAL" ENGINE.

The diagram which we give below shows the consumption of steam per I.H.P. in a 45 H.P. compound tandem single crank "Universal" engine, the tests being made at the Loughborough works of the Brush Electrical Engineering Company, Limited, on August 26th. At full load it will be seen that the steam consumption was only 20 lbs., while at half load it is about 22·75 lbs. To verify these results, so excellent in a non-condensing engine of this size, a party of a dozen gentlemen, including Mr. R. E. Crompton, Mr. Beaumont, Mr. Holmes, of Newcastle, Mr. Geoghegan, of Guinness's, and others were invited down to Loughborough, on Wednesday last, by the Brush Company, when a fresh series of trials were made, which, as will be seen later, more than corroborate the results shown in the curve.



The boiler pressure was 140 lbs., revolutions per minute 450, and the diameter of the cylinders $9\frac{13}{16}$ and $14\frac{1}{2}$ inches for the high and low pressures respectively, with a 6 inch stroke.

The steam was taken from the works' pipe some 40 to 50 feet away from the boiler, and a Crosby's indicator with an 80lb. spring produced the diagrams of both cylinders. Although Mr. Druitt Halpin has said that nothing will lie more consistently than a steam engine indicator, except a voltmeter and ammeter, we have no reason to doubt the accuracy of the readings, as quite a number of diagrams were taken for each sets of tests. The Crosby instrument has latterly come very largely into use for indicating at very high speeds, and is considered a very reliable indicator. An objection sometimes raised against it is the smallness of its diagrams, and so far as regards engines running at only moderate speeds, where large diagrams may be satisfactorily obtained, the objection may have some weight, but for engines at high speeds it is better to sacrifice bulkiness of diagram for a more accurate outline.

Three separate measurements at about full load, *i.e.*, 43, 42·3, and 44·8 H.P. respectively, gave 19·8 lbs. of steam per I.H.P. in each instance, and tests at somewhat more than half-load, viz., 33·5 H.P., resulted in a consumption of 20·1 lbs. of steam.

These figures, it will be seen, are practically in accordance with the results obtained in the presence of the purchaser's engineer, Mr. H. B. Spencer, of Manchester.

It is not necessary here to enter into any details of the "Universal" engine, as it was fully described and illustrated in the Electrical Review for March 20th of this year.

We may, however, state that it has a powerful shaft governor, which is claimed to be less costly than any existing throttle valve governors, and which controls the speed within 1 per cent.

It also governs thoroughly without a heavy fly-wheel and without regulation of steam to each cylinder individually; and, with automatic expansion, it is said to be more economical at all loads than other engines with throttle governors, and it differs from the general run of high speed engines in being reversible. Water cannot lodge in the cylinders, and it has neither drain cocks nor relief valves, because none are required.

The connecting rod is in two separate parts, and the manner in which wear is taken up by a powerful right and left-hand screw adjustment is exceedingly neat and effective, and this, with the eccentric rod joint, which is very easy to set up, form two of the best features in the engine.

Its remarkably smooth and quiet running afforded general satisfaction to the visitors, and altogether it can be said that Mr. Raworth's simple, strong, economical and comparatively cheap prime mover fills a real want, and it may therefore be rightly considered as one of the most promising of all high speed engines, an opinion in which all the experts present were agreed.

As it can be easily repaired by any mechanical engineer, it seems eminently suited for work in the Colonies, especially as

it cannot be injured by forgetfulness or inexperience. Another excellent feature is its readiness to accommodate itself to suddenly fluctuating loads. So it might be worth the while of those who are working tram lines by electric traction to bear this in mind.

CORRESPONDENCE.

"A Problem in Electro-Dynamics."

In the comments on this "problem" (August 21st) it is stated :—"That cutting the lines of force by a conductor sets up E.M.F., is, however, only a convenient fiction of theory, and not an absolute fact," &c. How is one to explain the working of a machine in which a simple conductor revolves in a uniform magnetic field ? Perhaps the simplest form of machine of this type is a hollow cylindrical conductor revolving between the lips of a magnet (fig. 1), of which one

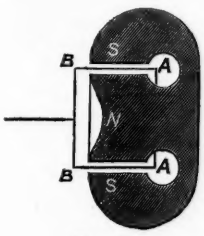


Fig. 1.

pole (S) completely surrounds the cylinder, and the other (N) is enclosed by it. There will then be an E.M.F. set up between A and B, the ends of the cylinder.

It is not at once apparent how the theory of the alteration of the flux density applies in a case of this kind. It is, of course, very convenient to use this theory when dealing with *coils*.

There are several types of false devices for producing continuous (or pulsatory) E.M.Fs. without commutators which, if tested by the cutting of the lines theory, appear, at first glance, to be workable. This is because the theory is not worked out to its logical end, in which case the conclusions agree with those arrived at by considering the flux density variation in the coil, which is supposed to produce a continuous E.M.F.

As an illustration of a simple fallacy :—

Suppose the ring armature (fig. 2) to be moved along, in its own plane, in a uniform magnetic field.

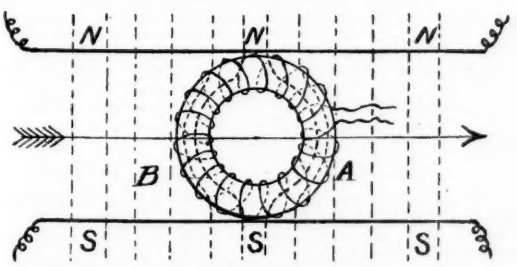


Fig. 2.

The wires at the top and bottom of the ring will cut the lines of force in such a way as to assist each other in producing an E.M.F. in the winding, which therefore appears to have a continuous E.M.F. set up in it.

To follow out the theory, one must see exactly how a typical line of force is cut by the winding on the armature as it moves along.

Firstly : Half the turns on the outside of the ring cut the line of force, and produce in the winding an E.M.F. in a certain direction, and the line takes up its position in the side, A, of the ring.

Secondly : The line of force must leave the side, A, and pass across to B, and in so doing it will be cut by all the turns of the winding on the inside of the ring, and an E.M.F. will be produced in the winding *in the other direction*.

Thirdly : The line of force is cut by the other half of the turns on the outside of the ring, and produces an E.M.F. in the winding in the original direction.

The algebraic sum of the effects produced is *nil*. As the armature moves along through the uniform field, some of the lines of force are in one position, whilst others are in the other positions, and consequently no E.M.F. will be set up in the armature. No doubt one would come to a correct result more rapidly by considering that the flux density in the winding, or any part thereof, does not alter.

Problems of this kind can be treated more generally by considering the action of a single line of force on a coil. Experimental investigation leads one to the conclusion that the line of force is a closed curve, and it will be considered as such. A line of force cutting into a coil sets up

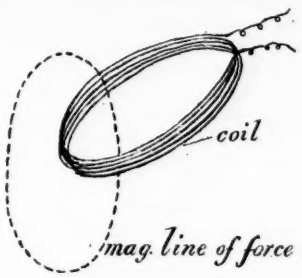


Fig. 3.

an E.M.F. in the coil, and, seeing that it is a closed curve, it cannot be withdrawn from the coil without cutting the coil, and so producing an E.M.F. in the opposite direction in the coil.

It might be suggested that a line of force be cut into a coil, then *reversed* (by changing the direction of the current producing it), and, finally, cut out again, and that the cutting in and cutting out would both produce an E.M.F. in the coil in the same direction ; this is quite right as far as it goes, but it does not consider what happens as the reversal takes place.

The answer to this is that the line of force does not remain where it was, and merely have its direction altered by changing the current ; but as the current decreases, it may be best considered to correspondingly *contract* in size, and as the current increases in the other direction it will *increase* in size till it takes up a position similar to its original one, but with different polarity. In doing this the line cuts the coil twice, hence the mere act of reversing the line of force neutralises the effect produced by cutting the line into the coil, and when reversed, cutting it out again.

The action of a transformer may be looked at in this way : One sees from this that a continuous (or pulsatory) current could only be set up in a coil by continually cutting lines of force into the coil (or *vice versâ*), which is absurd.

Hence it follows that a coil cannot be made the seat of a continuous E.M.F. by acting on it with magnetism in any way whatever. From this one sees at once that in the "problem in electro-dynamics" the coils, C and D, cannot possibly have a continuous or pulsatory current in them, even though the magnets be permanent.

If your correspondent would communicate with Mr. Carl Hering, also living on the other side of "the pond," he would no doubt be able to explain the matter more lucidly than I can.

Archibald H. Finlay, A.I.E.E.

Holywood, County Down,
August 28th, 1896.

THE BLACKPOOL INSTALLATION.

The important action of Mr. Robert C. Quin, the electrical engineer to the Corporation of Blackpool, in recommending certain alterations to the present system, seems to have filled the minds of some electrical people with grave misgivings,

while it has given the enemies of electric lighting—to wit, the gas people—an opportunity for considerable rejoicing. It is very true that the want of uniformity in the design of lighting systems strikes our opponents as one of the weakest points in electrical work; but, fortunately, this fact has not in the past hindered the growth of electric lighting, and with a wider acceptance of certain broad questions that now prevails, it is not likely to act as a deterring cause in the future. But while an electrical contemporary endeavours to point out that the gas people will not be slow to avail themselves of the Blackpool instance, and point out that as electrical matters are in a state of change, it is better to let them alone, it is not careful enough in avoiding exaggerations, if not misstatements. No doubt in the form in which our contemporary puts the instance, it may point a moral and adorn a tale; but it certainly plays into the hands of the opponents, because one who was not intimately acquainted with the electrical matters in provincial towns, might assume from our contemporary that Mr. Robt. Quin had gone to Blackpool, and was immediately undoing everything that had been previously done there. Indeed, our contemporary does not hesitate to condemn as un-English what it terms the scrap-heaping proclivities of some engineers.

There is a wide difference, however, between putting a system on the scrap heap and altering certain portions of it with a view to making it workable. It seems to us that Mr. Quin did not propose to do more than that. Whether the journal in question knows as much about the matter as Mr. R. Quin we leave for others to say. The sum of the great indictment which has been drawn up against the Borough electrical engineer is, that he wants to topsy turvey his predecessor's work. But surely the drastic measures that are proposed at Blackpool do not reflect on Mr. Quin's predecessor. Indeed, we have not the slightest hesitation in saying that if the former Borough electrical engineer at Blackpool had been responsible for the design and laying down of the plant, there would have been less need of alteration than exists at the present moment. As a matter of fact, there was no very great difference between Mr. Hesketh's scheme of gradual alteration and Mr. Quin's proposal of regeneration. We do not suggest that consulting electrical engineers are useless, for one cannot help admitting that magnificent results have attended works which have been laid down by them, but it is not to be denied that there are many generating systems in this country that deserve but little better fate than to be placed upon the scrap heap, and no amount of tinkering with "discouraging material" would ever make anything of them. It is only when a man with the courage of his convictions has to pronounce his views upon such plant that we hear the truth. We have little doubt that the excellent example set by Mr. Quin, of Blackpool, will be followed by others, and eventually we may succeed in obtaining systems against which it will be impossible for a new engineer to draw up an indictment.

The Council considered the matter of Mr. Quin's report on Monday, and unanimously adopted his recommendations regarding the system.

BUSINESS NOTICES, &c.

A Magnificent Work.—A work which promises to be one of the most exquisite of modern publications is "Men and Women of the Century," it being a collection of portraits and sketches by Mr. Rudolf Lehmann, edited by Mr. H. C. Marillier, B.A., Camb. The book is published by Messrs. George Bell & Sons, of London, conjointly with the Swan Electric Engraving Company, of 116, Charing Cross Road, who have carried out all the work of illustration, the prints representing a very high watermark of British reproduction processes. Mr. Lehmann's family connections have enabled him to make the book especially rich in science. There are excellent portraits of Du Bois Raymond and Sir Wm. Siemens, also such celebrities as A. von Humboldt, Huxley, Virchow, Brewster, Burdon-Sanderson, and Pasteur. Only 500 copies of the book are printed, and judging by specimen photographs, we believe there will be a ready demand for it. The price is £3 3s.

Auction Sale.—Messrs. Percy Huddlestone & Co. will offer for sale by public auction, at 80, Seel Street, Liverpool, on 10th inst., a quantity of electrical plant, including steam and gas engines, dynamos, &c., further particulars of which will be found in our "Advertisement Supplement."

Electrical Wares Exported.

Week Ending Sep. 1st, 1895.	£	s.
Algoa Bay	28	0
Alexandria. Teleph. mtl.	97	0
Amsterdam	16	0
Auckland	68	0
Bocca. Teleg. mtl. ...	59	0
Brussels	122	0
Buenos Ayres. Teleg. mtl.	154	0
Cape Town	446	0
Colombo	65	0
East London	659	0
Hong-Kong. Teleph. mtl.	79	0
" Teleph. mtl.	50	0
Madras	9	0
Martinique. Teleg. cable	10,800	0
Melbourne	390	0
Oporto. Teleg. mtl. ...	15	0
Singapore	10	0
Suez	25	0
" Teleg. mtl. ...	64	0
Sydney. Teleg. mtl. ...	225	0
Teneriffe	118	0
Wellington	83	0
Wiborg	88	0
Total	£13,670	0

Week Ending Sep. 1st, 1896.	£	s.
Adelaide. Teleg. mtl. ...	75	0
Amsterdam	275	0
Antwerp	70	0
Bombay	242	0
Buenos Ayres	194	0
Calcutta	1,343	0
Cape Town	215	0
Colombo	52	0
Durban	45	0
East London	41	0
Flushing	31	0
Fremantle	16	0
Hong Kong	30	0
Madras. Teleg. mtl. ...	77	0
Melbourne	100	0
" Teleg. mtl. ...	843	0
Passages	11	0
Port Elizabeth	581	0
Rockhampton	56	0
Rotterdam	44	0
Singapore	164	0
Sydney	366	0
Townsville	5	0
Wellington	91	0
Yokohama	78	0
Total ...	£5,045	0

Brockie-Pell Arc Lamp, Limited.—The offices of the above company are now situated at 97, Queen Victoria Street, E.C. Mr. J. D. Hurst is the secretary (*pro tem.*).

Business Announcement.—The Coventry Motor and Electrical Manufacturing Company, of Volt Works, Ryley Street, Coventry, have purchased the business of the Coventry Electrical Engineering Company, Limited. The business is to be carried on at the old address until the firm have completed the equipment of larger and more convenient works at Earlsdon. The firm has acquired the premises hitherto occupied by the Allard Cycle Company.

For Sale.—From our "Official Notices" particulars will be obtained of engineering works and foundry with engines, boilers, machinery, &c., which are offered for sale by Messrs. Shield & Kidd, of Dundee.

Lazare Weiller & Co.—Mr. Fernand Espir, of 3, East India Avenue, informs us that this company, for which he is the accredited agent for the United Kingdom, have just started at Havre important works for the manufacture of copper, bronze, steel and iron wires, and French wire nails. The new works are situated in close proximity to the quay at Havre, from whence vessels sail for all parts of the world, thus affording every facility for shipping any quantity at a moment's notice. The motive power of these works, which is equal to more than 3,000 H.P., is entirely distributed by electricity, and feeds 120 dynamos, working all the different shops. These rolling mills are of the most recent American type, and work automatically at high speeds, which permit of the removal, when hot, of all oxidation from the rod, by a mere mechanical action—a process which obviates the necessity of pickling, and thus improves, in the highest degree, the quality of the wire. Annealing is done by gas, and sheltered from atmospheric influences, whilst the processes of tinning and galvanisation are accomplished automatically and simultaneously with the drawing. The daily output of the Havre works is expected to attain to about 400 tons.

New Book.—Messrs. Whittaker & Co. are about to issue an authorised translation of Mr. D. Farman's recent and well-known work upon "Automobiles." It will be fully illustrated, and contain constructional details of the latest work. The translation has been carefully done by Mr. Lucien Serraillier.

Price List.—Messrs. W. M. Still & Co., of Charles Street, Hatton Garden, E.C., have sent us a price list of their incandescent electric lamps, of all shapes and sizes, also frosted, varnished, and other fancy lamps. They make a speciality of reflectors for incandescent lamps.

The Failure of Messrs. Paterson & Cooper.—At the London Bankruptcy Court, on Tuesday, the 1st inst., the first meeting of creditors was held under the failure of these debtors, electrical engineers, of 3, Prince's Mansions, Victoria Street, Westminster. The Official receiver, Mr. E. L. Hough, stated that the accounts had not yet been filed, but they were in course of preparation. Upon the making of the receiving order, he called together a preliminary meeting of creditors, at which it was agreed that Mr. Edward Moore, chartered accountant, should be appointed special manager pending the first meeting of creditors. The works had been carried on under the superintendence of Mr. Moore, who had provided the funds required for this purpose. The debtors estimated their liabilities at about £11,000, including cash advances amounting to £3,000. The assets were valued at over £18,000, exclusive of the debtor's interest in the Hermite patents, but these figures must at present be taken with some reserve, and it was doubtful if the assets would produce, under forced realisation, anything like the amount returned by the debtors. The causes of the insolvency were stated to be the withdrawal of capital from the business, the expenses of maintaining and perfecting the Hermite

patents, and the debtors' inability to promote a company to take over their interest in those patents; also law costs and heavy interest on borrowed money. No proposal was submitted, and resolutions were passed for the appointment of Mr. Edward Moore as trustee, with a committee of inspection, consisting of Mr. Campbell (Whitehouse and Thomas, Limited), Mr. H. Edmunds (Messrs. Glover & Co.), Mr. Marsh, Mr. Wetton, and Mr. F. D. Cooper as representing the cash creditors.

ELECTRIC LIGHTING NOTES.

Brighouse.—The Council has decided to apply for a provisional order. The plant is to be purchased from Mr. A. B. Brook, of Brighouse, for the sum of £1,535. The Council will pay him £100 per annum for the use of the overhead wires until they can themselves lay them underground.

Bristol.—The vacancy caused at the central station here by the removal of Mr. Collins Bishop to Leyton as chief electrical engineer, has been filled by the appointment of Mr. F. M. Rogers as third assistant engineer.

Burnley.—The mains are to be extended in Yorkshire Street to Plume Street at an estimated cost of £200, and should the trustees of a Wesleyan chapel in the vicinity undertake to use the new illuminant, there will be a further extension at an additional cost of £100.

Canterbury.—The invitation of tenders for the electric light installation and buildings has been delayed pending the selection of a new site. Matters are taking a long time to get into practical shape here, and there is a feeling in some minds that the scheme will eventually fall through.

Chester.—The new factory of the Chester and North Wales Ice and Cold Storage Company is lighted electrically, the plant having been supplied by the Howe Electrical Engineering Company.

Coatbridge.—The Scottish House-to-House Electricity Company has declined to light the street electric arc lamps at 15s. per lamp. The Lighting Committee is negotiating further with the company.

Coventry.—A large scheme for the erection of a model estate is in hand here; 763 small houses of the artisan dwelling type are to be erected, at a cost of £180,000, each being lighted by electricity.

Epsom.—The District Council has engaged Mr. Hawtayne, electrical engineer, to report on the question of electric lighting generally, and to advise reobtaining a provisional order, for the sum of 25 guineas.

Fort William.—The arc lamps for street lighting, which are supplied by Messrs. W. Macfarlane & Co., are very ornamental. There are three types in all, the overhanging arm, the upright, and a smaller upright, with a drinking fountain at foot.

Golborne.—The District Council have instructed their surveyor to make inquiries as to the cost of an electric lighting system. The Council at present pay 3s. 9d. per 1,000 for street lighting.

High Wycombe.—Nothing is at present being done *re* electric lighting, as the Electric Lighting Committee is still awaiting a reply from the company.

Islington.—It is stated that the income from the electric lighting during the quarter ended June 25th, is sufficient to pay the working expenses. Mr. Lambert is confident that the electric lighting scheme, so far as concerns the district between the Nag's Head and the Archway Tavern, will be successful; but he is somewhat sceptical as to the results in Caledonian Road.

Lincoln.—The Town Council, on Monday, formally resolved to apply for a provisional order.

Melbourne.—It has been definitely arranged that the central electric lighting station shall be established at the Spencer Street Railway Station, not only for the supply of the railway department, but also for the Parliament House, the General Post Office, and the Public Library.

Newmarket.—On Wednesday, October 7th, Mr. Westrope will move at the Council meeting that application be made for an electric lighting license or provisional order.

Nottingham.—The extensions at the electric lighting station in Talbot Street are rapidly approaching completion. The size of the structure will be practically doubled, and there are to be three new boilers and two new dynamos, each of 360 horse-power. The building operations have been carried out under the superintendence of the borough engineer, Mr. A. Brown, whilst the erection of the plant has been under the direction of the electrical engineer, Mr. H. Talbot.

South Shields.—Current was, on Tuesday last, September 1st, at 7.30 p.m., turned on at the central station. There was no opening ceremony.

Torquay.—The Local Government Board has sanctioned the application of the Council to borrow £20,000 for electric lighting purposes, and approved of the proposed situation of the works.

Worcester.—Mr. W. O. Hughes made a personal explanation to the City Council on Tuesday with regard to his resignation of the chairmanship of the water and sewerage, giving as his reason that he had lost confidence in the reports of the City engineer. He particularly referred to the fact that the committee decided to go in for pumping by electricity on the engineer's report that a saving of £600 a year would be effected; whereas he had since reported that the water could be pumped by steam for half the cost. Mr. Walter Caldicott defended the engineer, and said that he had been exonerated by the decision of the Deputy-Mayor, who was asked to arbitrate in the matter.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackburn.—The question of electric traction for the tramways in Blackburn is to again receive the attention of the Tramways Company. The Blackburn Corporation are about to apply to the Local Government Board for power to borrow £25,000 to increase the present electric plant, and the town clerk has informed the directors of the Tramways Company of this intention, and has suggested that the time is opportune for considering the advisability of substituting electricity for horses as the motive power on certain sections in the borough. Under these circumstances, a special meeting of the shareholders of the company has been called to take the matter into consideration. It will be remembered, says the *Blackburn Telegraph*, that at a meeting of the shareholders recently it was thought that the best time to adopt electric traction would be in two years' time, when the present engines and cars would have been used up. Should a decision be arrived at to substitute electricity for the present horse and steam traction, it is probable that the overhead system will be utilised.

Glasgow.—The Tramway Committee, on 28th ult., reconsidered the proposal to experimentally try the overhead trolley system on the Springburn route. The question discussed was whether the report already submitted to the Council should be reconsidered by the special sub-committee or allowed to lie on the table, and additional information obtained by the general manager for the Tramway Committee. After some discussion the committee divided, when, much to the general amusement of the members, it was found that, for a third time, the committee were equally divided on the question. Mr. W. Paton, the convener, again declined to give a casting vote, and the matter will come before the Corporation at its monthly meeting for a full discussion upon a simple report of the committee's proceedings.

New Ideas for Traction Men.—The *Street Railway Review* says:—What with trolley parties, straw parties, the innumerable attractions at street railway pleasure resorts, and other new-fangled ideas, one has to keep moving to be up with the developments brought about by electric railways. The very latest appears in a Michigan paper, in which a shrewd advertiser uses an interurban as the means to boom his sausages. The ad. reads:—

"The interurban is now running cars to Carrollton and Zilwaukie, and Stingel Bros. will give away street car tickets to every purchaser of every dollar's worth of meat at their People's Meat Market, 2,010, North Michigan Avenue. We make the best sausage in the city, and keep constantly on hand the best the market affords. Come and give us a call, and ride home on a street car free."

New York to Philadelphia.—The syndicate to which we referred a week or so back as having in hand a scheme for connecting New York and Philadelphia by electric railway, are to commence work shortly. They will use the overhead trolley; the line will be about 100 miles, and the company has a capital stock of $10,000,000. The New York *Electrical Engineer*, of August 19th, gives a note of the route, showing the towns and districts the line will pass through.

The Leeds Appointment.—There were 35 applicants for the position of Clerk of works in respect of the new lines of electric tramway. The Tramways Committee had five of these before them the other day, and finally decided by a very narrow majority to recommend the Council to appoint Mr. John Burbidge, who was manager for the Thomson-Houston Company on the Roundhay electric tramway. The salaries asked varied from £2 5s. to £5 15s. per week.

TELEGRAPH AND TELEPHONE NOTES.

The New French Cable.—We understand from a Paris paper that the submarine cable which is to be laid between Brest and New York has already been commenced, and will be completed by next summer. The new line will be open either in the month of August or September, 1897. Our contemporary says that the new trans-Atlantic cable, which will be nearly 6,000 kilometres long, will henceforth assure the independence and security of French telegraphic relations with the American Continent. In consequence, the Government has granted a subvention of 800,000 francs per annum for 30 years for the laying down and repair of the cable, which will be constructed and laid by exclusively French means, and will be under the control of the State.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (1869, Anglo)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Monte Alegre-Santarem ...	May 5th, 1896 ...	...
Para-Maranham	Aug. 6th, 1896 ...	...
Zanzibar-Mombassa	Aug. 23rd, 1896 ...	...
Landlines.		
Trans-Continental line beyond Mazol (Mashonaland)	March 12th, 1896 ...	...
Communication with Cartagena and Barranquilla, Columbia.	July 4th, 1896 ...	...
Salisbury-Umtali (cutting off communication with Beira)	July 10th, 1896 ...	...
Siberian lines, Radde-Khabarowska	Aug. 19th, 1896 ...	August 30th, 1896
Saigon-Bangkok	Aug. 29th, 1896 ...	August 30th, 1896

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—September 15th. Plans and tenders are being invited by the Municipal Authorities of Spa, for the lighting of the public streets by electricity, or by acetylene. Tenders and schemes are to be submitted to the Collége des Bourgmestre et Echevins, Spa.

Blackpool.—September 8th. The Corporation wants tenders for the supply, laying, and maintenance of high and low tension lead-covered cables, and the supply of all necessary jointing sundries. For particulars see our "Official Notices."

Cadiz.—September 15th. The Secretary of State for Foreign Affairs has received despatches from Her Majesty's Consul at Cadiz, stating that preliminary tenders for a supply of electric lighting apparatus for the illumination, on the most approved modern plan, of the private houses, &c., in the town of Cadiz, are invited by the "Sociedad Co-operativa Gaditano de Fabricacion de Gas." Tenders should be sent in by September 15th, to the above-named company, whose offices are San José, 25, 27, and 29, Cadiz. Firms wishing to obtain the contract for the supply of plant are advised by the Consul to send representatives to treat personally with the company. Such additional particulars as have reached Her Majesty's Government on the subject, may be viewed at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

Cork.—September 11th. The Corporation invites tenders from persons who are willing to carry the 1896 electric light provisional order into effect. The company securing the powers will have to supply current to the tramway company for working the tramways electrically. For further details see our "Official Notices."

Edinburgh.—September 22nd. Tenders are invited by the Corporation for coal hoist, gantry, and capstan; coal hoppers, measuring gear, and shoots; also hauling gear in coal store for the electric supply station. For further particulars see our "Official Notices."

France.—September 8th. Tenders wanted for the supply of a quantity of alternating current electro-magnetic calls. Tenders to be sent to the Direction Générale des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

Madras.—Nov. 11th. Lieut.-Col. C. C. Rawson (in charge Consulting Architects' Division) invites tenders for the lighting by electricity of Government House, Madras, including the banqueting hall and the A.D.C.'s bungalow: also for the lighting of Government House, Guindy, including the Military Secretary's bungalow. Particulars to be obtained on application to the Consulting Architect to the Government of Madras, Chepauk, Madras.

Madrid.—October 8th. The Secretary of State for Foreign Affairs learns from her Majesty's Ambassador at Madrid that the Spanish Government have invited tenders for the construction and working of a telephone system in Mayagüez in Porto Rico. October 8th is the date fixed for the consideration of tenders, and such particulars as her Majesty's Government have received may be inspected at the Commercial Department of the Foreign Office between the hours of 11 and 6 daily.

Oldham.—September 15th. The Electric Light Committee invite tenders for the various works required in the extension and alterations of the buildings of the electric light station in Gas Street, Oldham. Specifications, &c., to be seen on application to Mr. Arthur Andrew, Gas and Water Offices, Oldham.

South Africa.—October 1st. The Municipal Authorities of Bloemfontein are inviting tenders for supplying and laying down a complete electric lighting installation for the town. Tenderers are to submit a complete description, with plans and specifications, of their proposed scheme to W. A. Koller, Town Clerk, Bloemfontein, Orange Free State.

NOTES.

Electric Traction for Goods Traffic.—If the electric tramways for passenger service in this country do not yet number a single score, the number of those intended for goods and freight traffic is still less, and might easily be told off on the fingers of one hand. There is, of course, the Bessbrook and Newry line, where a considerable quantity of heavy goods is carried throughout the year, and there is a short line or siding at Rochdale worked by electric traction between the railway yard and a flannel manufactory. Many of the other lines—notably those in the Isle of Man—have perhaps been used for carrying material both during and after construction, but not on public account, or for trading as ordinary carriers. Yet there is no reason why an electric line for goods traffic should not be as convenient and profitable as one intended solely to accommodate passengers, when a source of electric energy (such, for instance, as a lighting station) is near at hand—a matter of frequent occurrence with large factories and warehouses. One is continually coming across descriptions in the American technical papers, of short goods lines served entirely by electric traction, where the greatest satisfaction is obtained. The last of these comprises a length of 1½ miles along private ground and streets in New Haven, Connecticut—built to serve a number of large factories that would otherwise have to cart all their material and product to and from the railway yard. The 30-ton electric locomotive shown at the Chicago World's Fair is to run on the line, having been bought for the express purpose. In the Southern States there are also many lines of a similar type, found especially useful for transporting cotton, coal, oils, &c., to and from the plantations and railway stations.

The Exploits of a "Yaller" Dog.—Harry Hoerle, writing in the *American Electrician*, says that some weeks ago a common "yaller" dog stepped on the main driving belt in the Elk Street station of the Buffalo General Electric Company, and was promptly carried under a 20-foot fly-wheel driving a 72-inch belt driven by an Allis tandem Corliss engine (48 inches stroke × 26 inches and 52 inches diameter). At the back of the wheel there is but 3 inches clearance between the pulley and an iron floor, which rests on a 5-inch I-beam built in the stone and cement foundation on either side. This was torn out of the foundation and the belt torn in two places, besides having a number of holes made in it which had to be patched. The belt, in swinging up, caught a 3-inch T-beam, which was but 8 inches from an arc circuit, and tore down the beam, leaving the wires intact; the beam, in falling, narrowly missed braining one of the assistant engineers. Strange to say, the dog was but little mutilated, although instantly killed. When the belt broke this threw the whole load, consisting of some 2,700 arc lamps, on a cross compound Allis-Corliss engine, 30 inches and 56 inches × 60 inches stroke, and with a 28-foot wheel; this engine carried the load the remainder of the night, there being no interruption of the service. This accident also broke the lightning apparatus and sprung the shaft out of line.

A Queer Phenomenon.—An American electrician, while engaged testing out a defective electric gas-lighting circuit, in order to assist in locating the leak by means of the accompanying spark, had an assistant turn the static generator while he made an examination in a dark attic. To his astonishment, he found the entire length of the wire in the attic luminous, the light given off being similar to that of a vacuum tube. A correspondent of the *American Electrician* has been trying, without success, to obtain an explanation of this strange effect.

Fire.—"Fusion of electric wires" is stated to be the cause of a fire which completely gutted the country house at Harpenden of Mr. A. Vaughan Stevens, the estimated damage being from £12,000 to £15,000. A complete electric lighting installation was put in a few years ago when the mansion was built. The loss is covered by insurance. The fire seems to have spread rapidly along the skirting, behind which ran the electric wires.

Eddy Current from Stray Field.—An American engineer records in a New York journal a peculiar incident which occurred in the course of his practice in dynamo design. His firm had been for a long time making a smooth-body drum armature, consisting of discs set upon the shaft with thick end discs and large nuts. The armature heads were of the over-wound type, and they had trouble with the frequent burning-out of the heads next the pulley. For a time they were at a loss to account for it. As they gradually improved their machinery, they adopted the Eickemeyer winding, which left this large nut at the end of the armature bare. From that time they had no trouble. One day when testing one of the machines of this type, the engineer happened to feel this nut. It was so hot that it scorched his fingers, and he was quite severely burned. "This heat," he adds, "was evidently caused by the eddy currents generated in it by the stray field. Herein might lie the explanation of similar trouble noted by others." Mr. Crompton "could a tale unfold" on this subject we expect!

British Association.—Preparations for the Liverpool meeting, which opens on Wednesday, September 16th, are well in hand. The President (Sir Joseph Lister) will deliver his address in the evening of the 16th in the Philharmonic Hall. Among the presidents of sections are Dr. Ludwig Mond, Prof. J. J. Thomson, Mr. J. E. Marr, Hon. Leonard Courtney, M.P., Sir Douglas Fox, Mr. Arthur J. Evans, Dr. D. H. Scott, and Dr. W. H. Gaskell. One of the popular lectures will be delivered by Dr. J. A. Fleming, who will take for his subject, "The Earth as a Great Magnet." There will be excursions to the Isle of Man and to the Lake District.

Refining Silver by Electrolysis. — The electrolytic method for refining silver which was devised by Möbius some time ago, appears to be in successful operation now at the works of the Pennsylvania Lead Company and elsewhere. The process is distinctly interesting on account of the new features which it involves. The silver to be refined is first treated by ordinary well-known metallurgical processes to reduce the quantity of other metals present (lead, copper, bismuth, &c.) to at most 2 per cent. It is then cast in sheets measuring 45 × 25 × 1·3 cm., and weighing 13—15 kilos. each. These serve as anodes. The cathodes are formed of thin, rolled sheets of pure silver, 33 × 55 × 2 cm. in size. The electrolyte is a solution of the nitrate of copper and silver, to which 0·5 — 1 per cent. of nitric acid is added to prevent the deposition of the copper. Four cathodes and three anodes are placed in each cell at distances apart severally of 43 mm. The anodes are enclosed in muslin bags for the purpose of intercepting the undissolved matters which fall from them as the action proceeds. These consist of gold bismuth, the principal portion of the lead (in the form of dioxide), and a little silver and copper. A sheet of woollen cloth stretched on a frame near the bottom of each cell catches the silver as it is removed from the cathodes by a mechanically moved wooden scraper. The intensity of the current employed is 18 amperes per square foot of cathode surface. The silver is collected from each cell at intervals of two days, the gold once a week. The silver is washed with water and then melted in graphite retorts capable of holding 560 kilos. each, and is thus obtained of a fineness of 999—999·5. The residue of gold, &c., after being melted, granulated, and treated with acid, gives gold of a fineness of 996—998. In the above process, care must be taken that the amount of copper in the electrolyte does not exceed 4-5 per cent., as otherwise the silver is not obtained in a pure state. If any of our readers are interested in the original paper from which this abstract is made, they will find it in the *Oesterr. Zeits. für Berg. und Huttenw.*, 1896, Vol. xliv., page 30.

Gas.—An escape of Gas at Calton, Glasgow, rendered four persons unconscious as they lay in bed on 28th ult., and for a long while their condition was most serious. Two deaths have since occurred.

At Stratford-on-Avon, on 28th ult., a gas explosion in Albany Place partially wrecked several houses, and injured a lady occupant.

At 45, Stapleton Hall Road, Stroud Green, on 1st inst., a gas explosion did the usual work of wrecking and injuring.

Catalytic Action of Nitrous Acid, and the Potential of Nitric Acid.—If the oxidation of the hydrogen ions, in the case of a Groves cell, is not sufficiently rapid, polarisation occurs, as is well known, and the E.M.F. falls considerably. This oxidation velocity is largely dependent on the concentration of the acid, and is increased by the addition of small quantities of nitrous acid. Thus, although polarisation with a pure acid occurred when the concentration was 35 per cent., by the addition of five drops of a nitrite solution the acid could be further diluted to 20 per cent., without any polarisation. Owing to this action of nitrous acid, urea and strong oxidising agents, such as potassium permanganate, have a retarding effect on the oxidation velocity, which may further be increased by some reducing agents. The potential of the nitric acid increases with the concentration, the values 1·23 volt at 6 per cent., and 1·52 volt at 5 per cent., being obtained. Nitrous acid, however, lowers the potential, and its effect in this respect was found to be a logarithmic function of its concentration. The potential of nitrous acid itself was found to be lower than that of nitric acid. These results have been obtained by Rudolf Ihlein, a research which is described fully in the *Zeitschrift für Physikalische Chemie*, 1896, Vol. xix., page 577—591.

The Dilution Law of Electrolytes.—In the *Zeitschrift für Physikalische Chemie*, L. Storch gives an account of a new law for electrolytes which he has discovered. He has obtained a dilution law of the form $\left(\frac{u}{v\,u_\infty}\right)^x = k\left(\frac{u_\infty - u}{v\,u_\infty}\right)^m$ where u_∞ and u are the molecular conductivities at infinite dilution and volume v respectively. This may be expressed as $x \log (u/v) = \log (u_\infty - u/v) + \log (k\,u_\infty{}^{x-1})$. By the construction of curves with Kohlrausch's values for u/v, and a probable u_∞, values for x and $(k\,u_\infty{}^{x-1})$ are obtained, and hence, by recalculation, the actual value of u_∞. The value for x differs for different electrolytes; but in the 12 cases considered, varies only between 1·400 and 1·577, and the conductivities then calculated from the formula agree very closely with the observed numbers. It is seen that the above formula for the value $x = 1{\cdot}5$ identical with that obtained by Van't Hoff, from Rudolphi's numbers. For very high concentrations, however, the formulæ are not valid; thus, from $v = 0{\cdot}33$, 1 and 2, the values $x = 1{\cdot}699$, $u = 104$ were obtained for potassium chloride, the corresponding values derived from $v = 10$ to 16,667 being 1·435 and 122; the lower values for u_∞ probably indicate the presence of double molecules in the more concentrated solutions. For further details consult the *Zeitschrift für Physikalische Chemie*, 1896, Vol. xix., page 13.

The Electric Furnace for Iron and Steel.—In the blast-furnace method of reducing iron the metal takes up impurities such as sulphur and silicon, and these are entirely removed in subsequent treatment by the Bessemer or Martin process. The present methods of smelting must hold the field for ordinary grades of iron; but when purity is of importance, and when special qualities of steel are required, it will probably prove advantageous to prepare pure iron by electrical methods of reduction, and to carbonise this subsequently. A furnace suitable for this and similar purposes is described by R. Urbanitzky in the *Zeitschrift für Elektrochemie*, *vide* Vol. ii., page 350. It is lined with a basic lining, like a Bessemer converter; this is non-conducting and almost infusible, and keeps the iron free from impurities. In the Heroult furnace used at Neuhausen, the positive carbon is vertical, and the material to be used has to be introduced into the narrow space between this and the walls of the furnace. It is preferable to have a positive electrode, consisting of four carbons arranged symmetrically about a vertical axis, and inclined at about 20° to it. These can be raised so as to produce an electric arc, or lowered, so as to dip into the fused mass; they can also be rotated backwards and forwards, so as to form a uniform distribution of the heat. The bottom of the furnace is insulated, and forms the negative electrode; it may either be formed of carbon, or of metal cooled by a powerful air current. Estimates of the *probable* working expense are given in the original paper.

The "Scientific American."—A splendid piece of enterprise in technical journalism is the fiftieth anniversary number of the *Scientific American*, which was published in July. Our contemporary's ordinary issues are always interesting, and contain many attractive illustrations, but this special number which is before us far outshines all others. At the venerable age of 50 years, it seems very appropriate for the editors to look back over the journal's past life and sum up all that has been done in science since its first number appeared (August, 1845). That an immense amount of labour has been incurred in making this issue a success will be understood when we give an outline of the articles. The history of the various branches of scientific work during the past half century is summed up in articles devoted to the following, the interest of these articles being materially added to by sketches and photographs of things as they were, contrasted with what they are to-day:—The effect of inventions on the people's life; the patent system; the trans-Atlantic steamship; railroads and bridges; the telegraph; physics; the textile industries of the United States; men of progress—American inventors; the submarine cable; photography; chemistry; the phonograph; the American locomotive; the bicycle; the progress made in the generation of electrical energy and its application to the operation of motors; the sewing machine; agricultural machinery; naval and coast defence; the printing business; steel; distinguished inventors; American shipbuilding; development of the astronomical telescope; the telephone; fifty years of the *Scientific American;* mining; unit transportation. There is also a special prize essay by Edward W. Byrn, A.M., on "The progress of invention during the past fifty years." We tender our contemporary our very hearty congratulations upon so splendid a number.

Steam Engines for Electric Generators.—Reading a paper before the Engineers Club, of Cleveland, Mr. E. A. Sperry describes a new form of engine, in which each piston stroke corresponds with a complete revolution of the crank-shaft. He recommends this in order that the Corliss engine, at present limited to speeds of 90 to 110 revolutions, may be used for direct driving, while at the same time a double speed is given to the generator, and its cost is thereby very greatly reduced, being pratically halved by reason of its smaller size and the greatly reduced number of the crossings required in the copper armature winding and commutator segments. A novel valve arrangement is also proposed. In place of one long Corliss valve, with very large clearance spaces in the end spaces or spandrils, he advocates two valves of half length, set at an angle with one another, thereby reducing the waste space very considerably. Mr. Sperry's idea seems to embody a desire to reduce generator costs by running these at a considerable velocity, while securing the advantages of a Corliss engine, which some people look upon as a sort of *summum bonum* for steam engine practice. He suggests the use of aluminium for certain parts of the Corliss valve gear, as a means whereby the possible velocity of the Corliss engine could be increased, on account of the enabling of the gear to operate more quickly, because of the reduced inertia of such aluminium parts.

A New (?) Marine Signalling Device.—Our New York namesake has the following:—

> The United States Consul at Copenhagen, Denmark, reports to the State Department that a young boatswain in the Danish Navy has invented a telegraphic apparatus for communication with a ship at a certain anchorage without the use of a direct line. An electric battery, with one pole in contact with moist earth at one end and a telegraphic key and interrupter at the other, constitute the Bland apparatus, from which a cable is laid to and around the anchorage in a coil from 1,000 to 1,200 feet in diameter. A solenoid connected with a telephone aboard the ship completes the apparatus. The plan has worked successfully, and the young inventor is now at work to get rid of the telegraph key and make the communication wholly telephonic. Among the advantages of the new method is that signals made in this manner will not be visible to an enemy, as in the case of flags, and that ships moving near the shore can communicate with stations while passing over certain spots before designated.

We fear the young boatswain is some years behind his time. He should have read the articles on this identical device in our own pages, and so should our New York contemporary.

Arc Lighting Statistics.—A preliminary report of the National Electric Light Association on arc lighting statistics, embracing about 400 cities and towns of the United States having a population of 5,000 or more, has just been issued, and gives for each locality the number of arcs, candle-power of each, price per night, and the time of burning. In glancing over the report, the *Electrical World* notices a wide variation in the cost of street lighting, one municipal plant reporting a cost of $36 per year for 1,200-C.P. lamps burning seven hours per night under a moonlight schedule, while the price paid in one of the largest cities is $182.50 per year for the same candle-power arcs burning all night. A second city contract was let for a period of five years for 130 1,200-C.P. arcs burning until midnight at $36 per arc per annum. The report shows that the rates in four municipalities are above $180 per annum, while in one municipality above $170; in five above $160; in six above $150; in nine above $140; in 10 above $130; in 31 above $120; in 28 above $110; in 58 above $100; in 73 above $90; in 61 above $80; in 64 above $70; in 34 above $60; in 14 above $50; and in nine above $40. Of the 33 municipal plants mentioned, 10 failed to report, and of the remaining 23 which reported, the cost for nine ranges from $50 for 1,500 C.P. arcs to $96 for 2,000 C.P. arcs burning all night, and for the remaining 14 from $36 for 1,200 C.P. arcs to $70 for 2,000 C.P. arcs burning on a moonlight schedule.

220-Volt Lamps.—Mr. Converse D. Marsh, writing in the *American Electrician*, says:—"Although high voltage lamps were used experimentally in two stations in this country for several years, they were not practically employed until Mr. W. N. Stewart, of Minneapolis, representing the Siemens & Halske Company, applied to my company for a 220-volt lamp, with which to compete with the Edison three-wire system. The number of successful plants now installed and running attest the complete victory of the high voltage system in central stations of moderate size, operating over somewhat scattered territory. Following in our wake, many attempts have been made to produce a standard of 220-volt lamps, consisting of a single filament supported in the middle of its length. We are now able to produce these lamps at an efficiency slightly below 4 watts per candle-power, and their excellent life is well shown by the many expressions of approval we have received. Not only are they used by central stations, but many power plants running on a voltage of from 200 to 550 are employing them. We have made them up as high as 260 volts. Reports from users indicate that alterations in wiring are inconsiderable. Strange as it may appear, the breaking of the arc by key sockets is more successfully done with 220 volts pressure than with 110, the long drawn yellow flame being succeeded by a short blue spark when the circuit is interrupted. Our lamps have been in active use since the summer of 1894, and we attribute our success in their manufacture at such a comparatively early period, to the fact that our workman, to whom the chief steps in the manufacture were entrusted, had experience in the production of high voltage lamps dating back to 1891."

Electrozone.—Electrolysed salt water, besides its use as a disinfectant for sewage, is now employed as an antiseptic in Paris hospitals. Dr. Proger, chief surgeon of the Deaf and Dumb Children's Asylum at Asmeres, recently told the Académie de Médicine, as the result of long experiments, that "the electrolysed saline water is neither caustic nor irritating; it may be applied to the mucous membrane as to the skin; it instantly removes all bad odours; stops all putrescent fermentation; kills microbes more effectually and rapidly than any other antiseptic; cleanses and heals fetid wounds and sores, and hastens healing; it is an ideal antiseptic. Consequently, it appears to me of the utmost importance to make it known, and to draw attention to all the applications that it may be put to both from a domestic point of view for deodorising and cleaning, and from a medical point of view as an antiseptic and healer *par excellence*." An American exchange says that Dr. Proger used the preventive and disinfectant with success in cases of angina, coryza, and incipient diphtheria as well, the Hermite process of production being employed.

Physiological Action of Currents of High Frequency. This subject has frequently been before the Paris Academy of Science, and on June 29th last, Mons. A. D'Arsonval made a further communication concerning it. In previous communications he has shown that organic combustion is increased under the influence of high-frequency currents, whether these currents traverse the living tissues transversely or take their origin by induction in the way which has been termed auto-induction. The author thought it interesting to follow up the study of these phenomena by submitting living beings to experiments during a considerable time, in order to see whether any of their functions were at all modified, and especially in order to determine whether any alterations could be observed when these creatures had been inoculated pathogenically. It will be realised that the difficulties in the way of this investigation were very considerable. However, D'Arsonval is not a man to stop in the face of difficulties, whatever they may be, and consequently he devised a system of experiment, based upon the researches of Hertz, Tesla, Elihu Thomson and Lord Kelvin, and in the end succeeded in eliminating the inconveniences which are inherent to observations of this kind. If our readers wish to follow the author through the details of his experiment, we must refer them either to the *Comptes Rendus* for June 29th, 1896, to pages 82 and 83 of *l'Electricien*, or else to the *Revue d'Electricité*, pages 183 to 186, where the original paper is reproduced almost in its entirety. For our purpose it is sufficient to notice the results which were obtained. D'Arsonval had already shown that organic combustion, in a living organism, placed within a solenoid, was very considerably increased, and the chief aim of his present experiments was to endeavour to show definitely that the functions of the animal being quickened, and more energy being expended, the weight of the animal would be rapidly diminished. He succeeded in verifying this expectation completely. A small pig placed within a solenoid and subjected for 16 hours to the action of high-frequency currents, was found to lose a notable amount of weight, which was five times greater than it lost during the same period when not exposed to the action of the current. This result is in accordance with some experiments made long ago by Regnault and Reisset. Experiments with other animals completely proved that when they are exposed to the action of high frequency currents the whole of their functions are very sensibly quickened, and this is evidenced by a notable decrease in weight. Mons. D'Arsonval contents himself for the present with merely noticing these facts, but it is clear, from the last paragraph of his paper, that he intends to follow up this interesting study, and no doubt will succeed in deducing from it some interesting conclusions.

Electric Repulsion.—Our contemporary, the *Optician*, cannot altogether agree with the view enunciated by Prof. Osmund on this subject. "Unfortunately for the new theory," says this authority, "electrical repulsion manifests itself in every direction with the same force, and not, like gravity, in some directions more powerfully than in others. *Du choc des esprits jaillit la lumière*; but we were under the impression that the repulsion—supposing it to be something more than an appearance due to an external attracting force—was exerted approximately in the line, or lines, joining the centres of figure of the similarly charged bodies. The term *force* sometimes does duty for values of very diverse nature (to us it means invariably either *pressure* or *pull*); but when two charged spheres apparently repel each other, or when the divergence of the gold leaves of an electrometer is augmented by the proximity of our two hands, we fail to perceive that the repulsion manifests itself in every direction with the same force."

Requires Editing.—The new editor of a contemporary, we are told, "has had many years experience in technical literature, and is widely known as a consulting engineer and scientific expert;" but a glance at one of the series of articles now running in the pages of that journal, seems to indicate that the writer is not familiar with electrical machinery or electrical terms. The article looks very much like a translation by the pen of one unacquainted with technical literature.

Notes on Aluminium and Its Alloys.—The British Aluminium Company, Limited, has favoured us with a copy of a pamphlet on aluminium and its alloys, which they have prepared for the guidance of those who are likely to work them. In this little pamphlet has been collected, in a very readable form, practically all the information of any consequence which can be obtained from France, Germany, America, and this country. It is rather amusing to notice that "this country" evidently means, in the opinion of the British Aluminium Company, "our own factories in England." Surely they must be aware that they are not the only people who have made practical experiments upon aluminium and its alloys. However, we have nothing to find fault with in that, it is a bit of commercialism, and of course the British Aluminium Company exists for commercial purposes. The pamphlet is really exceedingly well done. There are sections on the history of the metal, its properties—physical and chemical—the methods of melting, casting, forging, rolling, annealing, hardening, drawing, dressing, stamping, adapting, frosting, engraving, polishing, burnishing, painting, japanning, enamelling—mechanical and electro—and soldering. It is wonderful how much more can be done with this metal than the average metal worker has any idea of. There are also some accounts of different alloys manufactured by the company, and some very useful tables complete the pamphlet. It would be rather useful if other firms were as enterprising as this company. We seem to be approaching a new era in commercial life, in which, instead of secreting information, commercial firms endeavour to disseminate it. We are certain that this method will realise an advantageous result to those who adopt it.

Electricity on the New Currency.—The new $2 and $5 silver certificates have been printed and are ready for issue. Like the $1 certificates, they are a striking departure in money-making. Black ink is used in printing the front of the notes, while the back is of the conventional green. The $2 note was designed by Edwin H. Blashfield, of New York, and the face contains an allegorical representation of "Science Presenting Steam and Electricity to Commerce and Manufacture," and consists, says the New York *Electrical Engineer*, of five partly nude female figures in graceful poses. Walter Shirlaw, of New York, designed the $5 note. The face has an allegorical picture representing "America enlightening the World," a beautiful female, partly nude, holding in her right hand, uplifted, a lighted incandescent lamp. Reclining at her feet is a figure of Fame with the traditional trumpet.

Switchboard Protection.—"A Superintendent," writing in the *Western Electrician*, says:—

We have a switchboard that was built for 1,000 volts, and 2,000 volt machines are connected to it. We will have a new switchboard soon. Whenever we throw a switch the current arcs across and then flies on to something else within reach, the result being that the switchboard is a hard-looking affair most of the time. The switchboard is not to blame for it, though, because it was connected that way when the 2,000 volt machines were first put in, and, as is usual in such cases, it will be left to do the work as long as it can stand it. There are so many needed changes yet to be made that the most important ones have taken precedence, so far, and will continue to until all is in proper shape. The only thing that has protected our switchboard for so long a time has been dry river sand, which is used for extinguishing the arcs. A bucketful of dry river sand is kept within convenient reach of the switchboard, and it is customary with the man who throws a switch to have the other hand full of sand at the time, and as soon as the arc forms he uses the sand to smother it. This works effectually, and has preserved the switchboard until the present time, although it is a back number and out-of-date affair.

Electrical Engineering in Alsace.—The Société Alsacienne de Constructions Mecaniques, of Mulhouse, has lately put down an electric power transmission plant at its works. The various shops were previously lighted by electricity by means of several small plants, but it was decided to remove these and establish a large central station. This comprises a 150 H.P. vertical triple-expansion engine driving a continuous current dynamo giving 400 amperes at 250 volts. This plant is used for lighting purposes, and is capable of supplying current to 120 arc lamps and 400 incandescent lamps. The power plant consists of a 150 H.P. engine and a three-phase alternator. The latter set actuates 27 electromotors in various parts of the works connected with machine tools, ventilators, cranes, &c.

Bicyclists and Lightning.—A lot of nonsense has recently been published in the pages of non-technical and quasi-scientific papers, to the effect that a man mounted on a bicycle is perfectly safe in a thunderstorm, because he is supposed to be insulated from the earth by the rubber tyres of his machine. The following instance from the *Western Electrician* of a bicyclist having been killed by lightning may perhaps have the effect of destroying this pretty little fiction:—During the severe storm which visited Chicago on August 6th, Walter Scott, a bicyclist, was instantly killed by lightning while hurrying home on his wheel. The fatality occurred near the corner of Calumet Avenue and Fiftieth Street, and was witnessed by several men who had sought shelter from the storm in a neighbouring doorway. It seems that the lightning struck Mr. Scott on the crown of his head while he was bending over the handle-bars of his wheel, tearing his cap, shirt, and coat to fragments, and severely burning his chest and abdomen. On his cap Mr. Scott wore a silver badge of the Independent Cycling Club, of which he was a prominent member, which disappeared entirely. A gold ring which he wore was tarnished, but his silver watch was not at all affected. Mr. Scott was buried in Oakwoods Cemetery on August 8th. About 40 of his late club comrades were present, six of them acting as pall-bearers. The fact that Mr. Scott was soon to have been married to Miss Minnie Scott, of Battle Creek, Mich., was a particularly sad feature of the unfortunate affair. Many wheelmen have relied upon their rubber tyres for safety while astride of their steel machines during electrical storms, thinking themselves well insulated from the ground thereby. As in the case of young Scott, however, the tyres are usually covered with a film of water from the rainfall, and the accident shows that they are not to be relied upon as adequate protection against the mighty electromotive force that bridges the great air-gap of a lightning stroke. The safest plan of procedure for bicyclists, as well as pedestrians, during a thunderstorm, is to seek the shelter of some building with doors and windows closed.

Digest of Physical Tests.—We have received the third quarterly issue of Rickle's digest of tests. It purports to be a *résumé* of practical tests made in the laboratories of the world, but it is also a magazine of testing, and contains articles of interest beyond the mere dry bones of test statistics. As examples of information here supplied, we may cite two. The specification of India-rubber hose required by the U.S. Navy Yard, and the elements of an 18-inch rolled girder, recently put on the market by the Pencoyd Iron Company. The table gives 17 numbers for each of the two sections in which the new beam is rolled, including not merely its size, sectional area, catalogue number, weight per foot, and load factor, but the radius of gyration on both axes and the square of same, the moment of inertia, and so on. Now, where is the English rolling mill that publishes similar figures. They don't do so, and they run the risk of American sections being ordered simply because the designer, it may be in China, has got hold of an American rolling mill catalogue, which saves him the trouble of making and calculating these figures for himself. An interesting note on the metal glucinum appears. Prof. Morse, is trying to develop it. Glucinum is of less specific gravity than aluminium, and has a greater electrical conductivity than copper. The intention is to secure its ready production in commercial quantities.

Enclosed Arc Lamps.—We learn from an American exchange that a company in the States has had such success with its enclosed arc 150 hour lamp (the "Pioneer") that the present staff is insufficient to cope with orders, and fresh appointments have been made for each department.

Transformers.—The weight of iron cores in all the transformers used in the United Kingdom was recently stated by Dr. Fleming to be not less than 400 tons, requiring at least 400 kilowatts to maintain magnetisation; this corresponds to about 1,600,000 kw.-hours per annum, or to at least 16,000,000 pounds of coal, equal to about 8,000 tons, costing about $30,000.

Some Abnormal Magnetic Observations in Russia.—In a recent number of *L'Industrie Electrique*, there is a letter by Mons. Moureaux, dated from Koursk, June 15th, 1896, in which he describes an anomalous magnetic condition which he observed on June 12th and 13th last. The place at which these phenomena were observed is called Kotchetovka, and is situated in the district of Obojaune, 51° latitude and 6°8′ longitude east of Poulkowa. Mons. Moureaux determined the three magnetic elements at 15 places within a breadth of about a square kilometre. The extreme values observed were as follows:—

Declination	...	... + 57° and − 43°
Inclination	...	... 79° and 48°
Horizontal component		... 0·166 and 0 589

These differences are excessive, but what is very much more remarkable is that the horizontal component here attains a value superior to the maximum value met with in the equatorial part of the world, where it does not exceed 0·4. Since the inclination at this point is not lower than 48, it results that the magnetic force here attains an enormous value. The number 0·589 would appear to be incredible, but Mons. Moureaux controlled it by making six other observations at neighbouring points, and obtained values varying between 0·48 and 0·58. He possesses data respecting 75 other stations in that part of the world, and there are very few indeed of them in which the values for the three magnetic elements are normal. Needless to say, the experiments were carefully made; the apparatus was always the same, and must be regarded as reliable. Those who have studied this question are beginning to discover that in very many cases it is the unexpected which happens. The subject is an extremely obscure one, yet one well worthy of the attention of scientists, and it is to be hoped that others having similar opportunities to those possessed by Mons. Moureaux will carefully record their observations, so that by-and-bye, when a sufficient number of data have been accumulated, it will be possible, perhaps, to proceed to some sort of generalisation.

The Influence of Electrolytic Dissociation, &c., on the Molecular Refraction.—In order to determine whether the hydrogen ion has a greater specific refraction than that of the combined atom, Messrs. Le Blanc and Rohland have determined the difference between the molecular refractions of (1) weakly dissociated; (2) strongly dissociated acids and their sodium salts, which are in all cases strongly dissociated. In the case of formic, acetic, glycollic, propionic, butyric, glyceric, and lactic acids, the difference in the molecular refractions varied between 3·08 and 3·72 (Gladstone), between 1·56 and 1·80 (Lorenz). For the more strongly dissociated acids, mono-, di-, and tri-chloracetic, nitric, and hydrochloric acids, the differences were 3·17 to 1·37, and 1·60 to 0·75, the number decreasing with dilution and dissociation, so that the hydrogen ion exerts a greater influence than the acid ion. The refraction of sulphuric and tartaric acids were found by Hallwachs to remain almost constant on dilution, a result probably due to the influence of the other ions. Experiments with bases were undertaken, but no similar conclusion regarding the hydroxyl ions could be established. Assuming the acid ion to have the same equivalent refraction as in combination, and the hydrogen to have the atomic refraction 1·05, the values for sodium and chlorine were found to be 2·69 and 6·61. The latter agrees well with the value 6·42, which is independently obtained from the differences between the bases and chlorides. The refractions of salts in the solid state and in solution were also compared, that of the solution being usually greater, but in both cases the molecular refraction appears approximately additive. The experiments with various solvents indicate also a specific influence of the solvent. The original paper will be found in the *Zeitung für Physikalische Chemie*, 1896, Vol. xix., pp. 261—286.

Water as a Non-Inductive Resistance.—An exchange states that Prof. Fleming has shown experimentally with a 2,000-volt alternator, loaded with a water resistance, that the latter is quite non-inductive, and that the readings of the amperes may be taken as a measurement of the voltage, and the product of the volts and amperes will represent correctly the power consumed.

The Treatment of Consumption.—A special committee has been appointed by the Academy of Sciences in Paris to study the method for the treatment of consumption now practised in Paris by Dr. Crotte. This commission, says the *Standard*, is composed of M. Chauveau, one of the most illustrious of French physiologists, Dr. d'Arsonval, an eminent biologist and a great electrician, and Professor Bouchard, who is regarded as one of the glories of French medicine. The Academy of Sciences was led to investigate the matter by Dr. Crotte's assertion that, by his treatment, he had within the last few months, succeeded in curing, or at least in greatly improving the condition of, six hundred out of eight hundred patients who had followed his treatment. His patients are said to be almost exclusively persons who had been pronounced incurable by hospital doctors. They are men, women and children belonging to the poorer classes of society, and consequently living under unfavourable hygienic conditions, whom he treats gratuitously. His method comprises the use of electricity and of antiseptics. In what manner the electricity acts is not very clear. "The static electricity which is employed may, according to the *Petit Journal*, which publishes a long article on the subject, kill the microbes by a miniature flash of lightning, or annihilate them by the ozone it creates in the diseased tissues. It may be, also, that it so tonifies the vital functions in general, that it gives the human organism sufficient strength to overcome the invisible enemies invading the lungs. Dr. Crotte affirms that the effect of the electricity is to open the way for the microbe-destroying antiseptic, and to permit the curative agent to traverse the skin, muscles, and bones, and reach the microbes in the cavities of the lungs." The result of the inquiry instituted by the Academy of Sciences will be awaited with considerable interest.

Storage Battery Traction.—Storage batteries have plenty of scope in electric traction work, so long as they are kept in the power-houses or sub-stations, and not upon the cars—at least for propelling purposes. Barking and Birmingham have in this country afforded two very useful object lessons; and it is hardly probable that municipal or consulting engineers will venture to propose the use of accumulators for driving the cars on any extensive system, as matters stand at present. They think otherwise, occasionally, in the United States, even now, and a storage battery road is being equipped in Chicago—at least so we are told. At the same time there is hope that common sense, not to say pounds, shillings, and pence, will ultimately prevail, for we read in one of the tramway periodicals that "if the storage battery has any merit as a means of street car traction it will be brought out by this road, as everything is new, and makeshifts will not have to be resorted to." Evidently there is not evinced here an overwhelming amount of trust in the system, else we should not have the conditional mood employed. One curious detail about the re-charging equipment is that three generators are to be employed of graded voltages. As the discharged batteries come in they are charged first by the lowest voltage generator, then changed over to the others, as the electromotive force rises. If the line is equipped for this winter, that will enable us to chronicle next autumn its conversion to trolley or conduit working.

Polarity Tester.—Ben. W. Clark, in the *American Electrician*, mentions a simple solution for a polarity tester. It consists of ten parts of distilled water to one of iodide of potassium. He uses distilled water to improve the keeping qualities of the solution. The positive pole was shown by a brown mark on the paper, and the action was instantaneous. It can be used with distance proportions, and for any reasonable voltage. Mr. Clark has used the iodide solution for about eight years, and finds it the best. Instead of water to dampen the paper, the user may dampen it with his mouth without the least fear, as it is perfectly harmless.

Electric Light for Defence Purposes.—A notice has been issued from the Trinity House, Hull, to the effect the War Department propose to work the "electric light established at Paull Battery for the defence of the Humber in connection with the submarine mining service" between certain hours."

Appointment.—Mr. John F. C. Snell, A.M.I.C.E. M.Inst.E.E., has been appointed borough electrical engineer at Sunderland, *vice* Mr. C. S. Vesey Brown, appointed to Lincoln. Mr. Snell is now resident engineer at the King's Road station, St. Pancras; was previously chief assistant at Stanhope Street station, chief assistant to Major-General Webber, C.B., R.E., consulting engineer, and an assistant engineer on Messrs. Crompton's staff, and engaged at Kensington Court, Notting Hill and Stockholm central stations.

A Good Hint!—As electric tramways become more popular, and horse tramways are abandoned, the cry may be heard, "What shall we do with our horses and horse-cars?" Many uses for the animals may be found, and the New York *Electrical World* now tells of a novel, but sensible, use which is being made of old horse-cars in Connecticut. As many as 600 of these old conveyances are now doing good service as summer cottages, hunters' camps, and temporary habitations for fishermen and others. What a capital idea for Henley, a Canterbury cricket week, or even the B.A. meeting, in a year or so?

Presentations.—Mr. A. T. Cooper, who has resigned his appointment as electrical engineer to the Blackpool Corporation to come to London as chief assistant to Mr. R. Hammond, was last week presented with a gold non-magnetic watch, subscribed for by the staff and employés at the Corporation Electricity Works, as a mark of their respect and esteem.

Mr. H. Faraday Proctor, the chief electrical engineer at Bristol central station, has been presented with a handsome silver tea and coffee service by the members of the Electrical Committee as a mark of their appreciation on the occasion of his marriage. Mr. Proctor has our best wishes for his future happiness. It is very pleasing to hear of such happy relations existing between an Electric Lighting Committee and its officials.

NEW COMPANY REGISTERED.

Northern Electrical Engineering and Plating Company, Limited.—Registered August 24th, capital £1,000 in £1 shares, to carry on the business of general and electrical and general engineers, electroplaters, shipbuilders, machinists, fitters, founders, millwrights, smiths, wire-drawers, metallurgists, metal merchants, &c. Miss C. Spencely, 25, Tower Street, East Sunderland; G. A. Spencely, 25, Tower Street, East Sunderland; R. W. Vander Ben, 12, Coburg Street, North Shields; D. Mackenzie, 13, Park Crescent, North Shields; T. A. Gurr, 31, Grep Street, North Shields, clerk; A. S. Fraser, 100, Bell Street, North Shields, ship furnisher; W. G. Vander Ben, 49, Gray Street, Newcastle, clerk, one share each. Table A mainly applies. Registered office, Brewery Lane, South Shields.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

J. E. H. Andrew & Co., Limited (22,223).—This company's annual return was filed on June 13th. The capital is £40,000, in £20 shares; 1,465 of these have been taken up, and 300 are considered as paid. The full amount has been called and paid, and £700 has also been paid in connection with the forfeiture of 35 shares.

J. H. Pickup & Co., Limited (34,051).—This company's annual return was filed on June 22nd. The capital is £25,000, in £5 shares, and 3,850 have been taken up, 800 are considered as paid, and the full amount has been called and paid on the rest.

Keighley Electrical Engineering Company, Limited (44,893).—This company, according to a notice filed August 8th, has resolved to issue 1,000 shares of £1 each, as £5 per cent. cumulative preference shares.

J. C. Howell, Limited (46,346).—This company's statutory return has just been filed. Seven shares have been taken up out of a capital of £10,000, in £1 shares, and no calls have as yet been made.

Keswick Electric Light Company, Limited (28,820).—This company's annual return has just been filed. The capital is £5,000, in £1 shares, and 3,420 shares have been subscribed for. The whole amount has been called and paid.

Larne Electric Light Works, Limited (46,962).—This company's statutory return was filed on July 7th. The capital is £4,000 in £1 shares (500 preference). All the ordinary have been taken up and considered as fully paid; 105 preference have also been subscribed for, and £105 has been received in connection therewith.

CITY NOTES.

The Industrial Inventions Development Company, Limited.

A few months ago we notified the formation of this company, and recorded some of its objects. A note of the proceedings of the first annual general meeting, held on August 21st, at the offices, 33, Cornhill, E.C., has been sent to us and reports that the operations for the first year ending June 30th, 1896, are thoroughly satisfactory. The profit and loss account and the general balance-sheet are printed below, therefore we need only refer to the general business which Mr. F. L. Rawson, as chairman, dwelt upon in his speech.

Profit and Loss Account for Year ending June 30th, 1896.

	£	s.	d.
To salaries	543	10	0
„ legal expenses and professional charges	693	2	0
„ rent, lighting, printing, stationery, office expenses, &c.	169	7	0
„ preliminary expenses...	283	0	0
„ sundries	16	18	9
„ balance, being net profit, carried to balance sheet...	1,228	0	4
	£2,933	18	1
By profit on sales of patents, &c.	2,545	4	7
„ commission account	297	9	6
„ interest account	91	4	0
„ shares not yet realised, par value £5,550			
	£2,933	18	1

Balance-Sheet at June 30th, 1896.

	£	s.	d.
To share capital:—			
Authorised:—			
50,000 shares of £1 each	50,000	0	0
Issued:—			
3,340 shares of £1 each, fully-paid	3,340	0	0
„ Sundry creditors	741	13	2
„ Liability in connection with special contract not yet completed, as *per contra*	9,500	0	0
„ Profit and loss account—			
Balance brought down	1,228	0	4
	£14,809	13	6
By Patents at cost price	2,500	0	0
„ Sundry debtors	867	1	10
„ Expenditure on patents, processes, and contracts in hand	1,575	3	10
„ Sundry shares received in part payment of patents, for commissions, &c., par value £5,550 (cost *nil*)			
„ Ditto, ditto £9,268 at amount expended in connection therewith	534	0	0
„ Cash due in connection with special contracts not yet completed, as *per contra*	9,300	0	0
„ Cash in hand	33	7	10
	£14,809	13	6

The company is engaged in litigation with the Incandescent Gas Light Company, and is confident of winning, and by the sale of a certain patent in incandescent gas mantles hopes to clear a profit of £5,000. Other processes which the company is exploiting are a method of making briquettes, and one for treating aluminium at an extra cost of about 1d. per lb., which increases the strength thereof, and also enables it, without any annealing, to be readily drawn into rigid tubes or rolled into plates. For further exploiting this latter process a syndicate is at present being formed to bring out a public company. The special objects of the company are stated to be the development of new inventions, the selling of inventions, and the placing of concessions and other rights. The company was also formed to take over the patent department (or financial business) of that unfortunate concern—Woodhouse & Rawson United, Limited. In order to allow shareholders and creditors of that company to participate in the profits of the new company, the secretary is now sending round a notice, which contains the following:—

"In accordance with the agreement made, the issue of 10,000 shares, preferential as to capital, and entitled to a cumulative preferential dividend of 7 per cent., and to one-fourth of the remaining profits, is now offered at par exclusively to the shareholders and creditors of Woodhouse & Rawson, United, and will be allotted strictly *pro rata*. As it is practically impossible to set out all the contracts entered into by the company, applicants will be deemed to have waived any further compliance with Section 38 of the Companies' Act, 1867. The lists will close on Monday, September 7th, and applications must be sent to the secretary before that date. A meeting of the applicants will be held at the offices of the company at 2.30 p.m. on that day, for the purpose of electing a director to represent their interests on the board of the company, and allotment will take place immediately afterwards."

The directors' report was unanimously adopted by the meeting, and Mr. Rawson and the auditors were re-elected. A dividend at the rate of 10 per cent. per annum was declared. An extraordinary general meeting was subsequently held, and certain resolutions passed.

Why did not the Press have notice of the meeting held on August 21st, as usual? Official reports may be all very well for shareholders, but the members of the Press generally prefer to make their own reports.

Sussmann's Electric Miner's Lamp Company.

The statutory meeting of this company was held on Monday at Cannon Street Hotel, the Earl of Westmoreland in the chair.

The statement made by the chairman was not a very encouraging one. There was very little new to be said, it seemed, beyond what appeared in the prospectus, save that the company had been in existence four months, and had done very little actual work. The Chairman stated, "We are extremely pleased with the work that has been accomplished," and then went on to explain that the Edison & Swan United Company were not yet in a position to accept orders for the lamp, but would be shortly, and then the Sussmann Company would go ahead with all possible speed. They were negotiating with Belgium, South Africa, and France, with regard to the sale of the foreign patents. They were shipping samples to India, and "if the lamp is favourably reported on there, I see," said the chairman, "a tremendous future for our lamp in that direction." There had been inquiries from collieries in England and Wales asking when the lamps would be ready. The shareholders would doubtless think the company should have supplied all demands, but "we do not think that we, as a company, should do it until we could supply all demands with satisfaction." "The lamp," said the Earl, "is absolutely the best invented for safe underground work; it is so clean, gives such a bright light, and is extremely handy. In my very humble opinion the lamp is perfect in every way," and the shareholders were to be congratulated upon being the owners of such a valuable patent.

From these remarks, it appeared that the company had been prevented taking orders, because the contract with the Edison & Swan Company was not fully arranged.

A Shareholder remarked that the prospectus told them just what was said by the chairman, and a pointed question was asked: "Have orders come from the different collieries?" The reply of the chairman was: "We have had orders, but have not been in a position to accept them."

Another Shareholder: I thought you said in the prospectus that you were ready to get to work at once, as the Edison-Swan Company had entered into a contract? Are you sufficiently advanced to say that the Edison & Swan Company have taken it up, and will proceed without loss of time?

The Chairman stated that various things had arisen to cause delays. There was a great eagerness upon the part of the collieries to take up the lamp. Regarding the shareholder's inquiry as to the contract with the Edison & Swan Company, his reply was, "I think I can say yes."

A number of the lamps of 1 C.P. were placed on exhibition at the meeting, and from what we saw of them, seemed to burn very well.

Babcock & Wilcox, Limited.—The directors have decided to recommend the payment of the following dividends as for the six months ending June 30th at the rates per annum of 6 per cent. on preference shares, and 20 per cent. on ordinary shares, payable on September 11th.

Commercial Cable Company.—The transfer books will be closed at 2.30 p.m. on 19th inst., and re-opened on the morning of October 2nd.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending August 30th, 1896, were £835; week ending September 1st, 1895, £786; increase, £49; total receipts for half-year 1896, £8,333; corresponding period, 1895, £7,669; increase, £664.

The Direct Spanish Telegraph Company. The estimated receipts for the month of August, 1896, were £2,038.

The Liverpool Overhead Railway Company. The receipts for the week ending August 30th, 1896, amounted to £1,300; corresponding week last year, £1,272; increase, £28.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending August 28th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,791.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Aug. 26th.	Closing Quotation, Sept. 2nd.	Business done during week ended Sept. 2nd, 1896. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	10C	4 %	4 %	4 %	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd. ...	Stock	£2 11s.	£2 2s.	£2 9s.	52 — 54	52 — 54	52⅛	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	97½— 98½	97½— 98½	98¼	97½
2,993,560£	Do. do. Defd. ...	Stock	...	...	...	9 — 9½	9 — 9½	9	...
130,000	Brasilian Submarine Teleg., Ltd.	10	6½% §	7 %	...	15½— 15⅝	15½— 15⅝	15⅝	15 9/16
75,000£	Do. do. 5 %, Debs., 2nd series, 1906 ...	100	5 %	5 %	5 %	112 —116	112 —116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000 ...	5	... §	2½%	4 %	3½— 4	3½— 4	...	...
10,000,000$	Commercial Cable Co. ...	$100	7 %	7 %	7 %	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	1½%	1 1/16— 1 3/16	1 1/16— 1 3/16	...	...
16,000	Cuba Teleg., Ltd. ...	10	8 %	8 %	8 %	12½— 13⅛	12½— 13⅛xd	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½— 21½	20¼— 21¼xd	...	...
12,931	Direct Spanish Teleg., Ltd. ...	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Direct United States Cable, Ltd. ...	50	...	4½%	4½%	107 —110%	107 —110 %	...	...
60,710	Eastern Teleg., Ltd., Nos. 1 to 400,000	20	2⅝% §	2 %	2¼%	9¾— 10¼	9¾— 10¼	9⅞	...
400,000	Do. 6 % Cum. Pref.	10	6¼% §	6¼%	6¼%	18 — 18½	18 — 18½	18⅝	18⅛
70,000	Do. 5 % Debs., repay. August, 1899	10	6 % §	6 %	6	18½— 19½	18½ — 19½	...	...
102,100£	Do. 4 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
1,297,837£	Eastern Extension, Australasia and China Teleg., Ltd.	Stock	4 %	4 %	4 %	131 —134	131 —134	133½	...
250,000	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs.	10	7 %	7 %	7 %	18 — 18½	18 — 18½	18⅝	18⅛
54,100£	Do. reg. 1 to 1,049, 3,976 to 4,326	}100	5 %	5 %	5 %	100 —104	100 —104	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock ...	Stock	4 %	4 %	4 %	130 —133	130 —133	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	}100	5 %	5 %	5 %	100 —104	100 —104	...	...
107,600£	Do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	101 —104	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	}100	4 %	4 %	4 %	106 —109	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	111 —114 %	111 —114 %	...	...
180,227	Globe Telegraph and Trust, Ltd. ...	10	4⅝% §	4½%	4½%	11½— 11¾	11½— 11⅝	11⅝	11½
180,042	Do. do. 6 % Pref. ...	10	6 % §	6 %	6 %	18 — 18½	18 — 18½	18 7/16	18⅜
150,000	Great Northern Teleg. Company of Copenhagen ...	10	8⅜%	8⅜%	10 %	24 — 25	24 — 25	25	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	105 —108	104 —107xd	...	...
17,000	Indo-European Teleg., Ltd. ...	25	10 %	10 %	10 %	53 — 56	53 — 56	54⅜	...
100,000£	London Platino-Brasilian Teleg., Ltd. 6 % Debs. ...	100	6 %	6 %	6 %	111 —114	109 —112 xd	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597 ...	5	5 % §	5 %	5½%	7½— 7¾	7½— 7¾	7⅞	7⅞
15,000	Do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	17 — 19	17 — 19	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	17 — 18	17 — 18	17½	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	10	6 %	6 %	6 %	6¾— 7	6¾— 7	6 15/16	...
1,100,000£	Do. 3½ % Deb. Stock Red.	5	5 %	5 %	5 %	107 —110	107 —110	108½	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	Stock	3½%	3½%	3½%	¾— ⅞	¾— ⅞	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	1	...	4½%	5 %				
11,839	Reuter's Ltd. ...	}100	4 %	4 %	4 %	108 — 111	108 —111	...	...
3,381	Submarine Cables Trust ...	8	0 %	*nil*	5 %	7 — 8	7 — 8	...	...
58,000	United River Plate Teleph., Ltd. ...	Cert.	...	...	...	140 —145	140 —145	141½	...
146,733£	Do. do. 5 % Debs. ...	5	...	3 %	4 %	3⅞— 4¼	3⅞— 4¼	...	...
15,509	West African Teleg., Ltd., 7,501 to 23,109 ...	Stock	5 %	5 %	5 %	101 —106	101 —106	...	...
238,300£	Do. do. do. 5 % Debs.	10	*nil*	*nil*	4 %	5 — 6	5 — 6	5½	...
30,000	West Coast of America Teleg., Ltd. ...	100	5 %	5 %	5 %	104 —107	102 —105 xd	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	10	*nil*	*nil*	*nil*	1 — 2	1 — 2	...	...
64,248	Western and Brasilian Teleg., Ltd. ...	100	8 %	8 %	8 %	99 —104	99 — 104	...	...
33,129	Do. do. do. 5 % Pref. Ord.	15	2½%	3 %	3 %	8⅝— 9¼	8⅝— 9¼	...	...
33,129	Do. do. do. Def. Ord. ...	7½	5 %	5 %	5 %	7 — 7½	7 — 7½	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red	7½	...	1 %	1 %	2¼— 2⅝	2¼— 2¾	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
88,321	West India and Panama Teleg., Ltd. ...	10	⅞%	⅞%	⅞%	103 —107	103 —107	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11½— 12	11½— 12	11 13/16	...
80,000£	Do. do. do. 5 % Debs. No. 1 to 1,800	100	5 %	5 %	5 %	9¾— 10½	9¾— 10½	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	108 —111	108 —111	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	110 —115	110 —115	...	...
						104 —107	100 —105 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply ...	5	4½%	4½%	5 %	9¼— 9⅝	9¼— 9⅝	9⅝	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7⅞— 8¼	7⅞— 8¼	8⅛	8
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4½%	114 —117	114 —117	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	16 — 17	16 — 17	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17½— 18½	17½— 18½	18⅜	18
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	132 —136	132 —136	135½	133
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	}10	...	...	*nil*	8 — 9	8 — 9	9	...
20,000	Do. do. do. 6% Pref., 40,001—50,000	10	...	...	6 %	13⅜— 14½	13⅜— 14½	14 3/16	...
10,000	Do. do. do. iss. at 2 pm., all paid ...	10	...	...	...	3½— 4½	5½— 6½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	2½%	3 %	4 %	13½— 13⅝	13 — 14	13⅝	13½
150,000£	Do. 4½% first mortgage debenture stock ...	...	4½%	4½%	4½%	120 —123	120 —123	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	11 — 12	11½— 12½	12½	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6¼%	7½%	12 — 13	12 — 13	12¼	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	106 —109	106 —109	...	...
67,900	Do. *Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	11 — 12	11 — 12	...	...

* Subject to Founder's Shares.

‡ Unless otherwise stated all shares are fully paid.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.

‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Aug. 26th.	Closing Quotation Sept. 2nd.	Business done during week ended Sept. 2nd, 1896. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	£	5 % §	2½%	...	1¼— 1½	1⅛— 1⅜	1⅜	1⅛
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	£	6 % §	3 %	...	1⅜— 1⅝	1⅜— 2	1⅞	1⅜
125,000	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	112 —115	110 —113xd	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	98 — 102	97 —101	97½	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	10½— 11	10⅛— 10⅜	10⅜	...
207,649	Do. do. do. £4 paid	10	...	...	...	2¼— 2½	4⅛— 4⅜	2⅜	...
630,000	City and South London Railway	Stock	1½%	1½%	1⅝%	50 — 52	51 — 53	52½	52
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	£	3 % §	*nil*	*nil*	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	£	7 %	5 %	5 %	1¾— 2¼	1¾— 2¼	2 3/16	2⅛
17,139	Do. do. do. "A" Shares 01—017,139	£	7 %	5 %	5 %	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	4½%	103 —106	103 —106	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	£	*nil*	*nil*	5 %	1⅛— 1⅜	1⅛— 1⅛xd	1 1/16	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	£	7 %	7 %	7 %	2⅜— 3½	2⅜— 3½xd	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	£	*nil*	*nil*	...	¾— 1	¾— 1	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	£	*nil*	*nil*	...	⅝— ⅝	⅝— ⅝	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	£	*nil*	*nil*	10½%	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	£	5 %	6 %	8 %	18 — 19	18 — 19xd	18 15/16	...
3,000	Do. do. do. 7% Pref.	£	7 %	7 %	7 %	18½— 19½	18½— 19½xd	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	112 —117	110 —115xd	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	£	12½%	10 %	10 %	22 — 23	22 — 23	22⅝	22¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	£	...	...	...	107 —110	107 —110	...	...
37,500	†Liverpool Overhead Railway, Ord.	£	1 %	1½%	2½%	13¼ — 13⅜xd	13¼ — 13⅜	...	...
10,000	† Do. do. Pref., £10 paid	£	5 %	5 %	5 %	16⅞— 17⅜xd	16⅞— 17⅜xd	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	£	20 %	20 %	15 %	39 — 42	40 — 43	42¼	41½
150,000	Do. do. do. 5 % Bonds, red. 1899	£	5 %	5 %	5 %	103 —106	104 —107	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	£	...	...	...	8 — 8½	8 — 8½	8 7/16	8 5/16

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%§; 1891—7%§ 1890—5%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 7⅞—8; £3 paid, 4¼.

Electric Construction Corporation, 6 % Debentures, 104—107.

House-to-House Company (£5 paid), 4—4½.

Do. do. 7 % Preference, of £5, 8⅜—9¼.

Do. do. 4½% Debentures of £100, 109—112.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 7⅞—8¼.

London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7½—8.

* From Birmingham Share List.

Bank rate of discount 2 per cent. (February 22nd, 1894).

A MODERN VILLAGE LIGHTING PLANT—NORWOOD, OHIO.*

By THOS. G. SMITH, Jun., M.E.

While all are familiar with the use of direct, constant potential current for operating incandescent lamps and motors, the application of this character of current to the operation of arc lamps for street service is in a measure new, and a description of one of the latest installations for this purpose may be of interest.

The plant about to be described is used primarily for the illumination of the streets of the village of Norwood, Ohio, and it is intended ultimately to furnish current for commercial purposes as well. At the present time the service is almost wholly devoted to the street lighting, with the exception of some 20 incandescent lamps in the station building and some few others now being connected on the commercial circuits. The street lights consist of about 150 arc lamps operated two in series on 220 volts. This is the largest number of lights of this type so far in use in any village lighting plant in this section of the country; and this station is probably the only one operating street lights exclusively, or in which the incandescent service is a small fraction of the entire load.

The station is a one-storey brick structure, with slate roof, built as an addition to the waterworks station; it is designed for the accommodation of three units of the present size, without encroaching on the space devoted to office purposes. The station has three exposures, south, west and north, with a gallery along the west end, forming a convenient storage and testing room.

The present generating unit consists of one 135 kilowatt multipolar, slow-speed dynamo mounted on the shaft of a 200 horse-power cross-compound, fixed cut-off engine; dynamo and fly-wheel located between the engine bearings. The dynamo is of the Siemens & Halske make, with outside commutator, and is fitted with their latest form of independent brush-holder ring, which is mounted on an adjustable pedestal, with roller bearings at three points; this ring is controlled by a hand wheel at the rear of the dynamo. The machine is compound wound and automatic in regulation.

The engine is of the cross-compound, fixed cut-off type built by Houston, Stanwood & Gamble, with a capacity of 200 horse-power, at 150 revolutions per minute, and 100 lbs. steam pressure, non-condensing. The engine frames are mounted on a sub-base which also furnishes support for two of the roller bearings for the brush-holder ring. The combination of a heavy fly-wheel, with a high speed form of throttling governor, gives excellent practical regulation.

The switchboard is of white marble fixed in a neatly-finished oak frame, located at the centre of the east side of the building, three feet from the wall. On this board are mounted the instruments and switches for the control and operation of the plant, as follows: Ampere and volt meters of the Weston circular pattern; main and circuit switches of the Electric Engineering and Supply Company, tubular frame type; Westinghouse circuit-breaker; voltmeter switch; ground detectors; rheostat hand wheel and switchboard lights. The circuits from the board are carried overhead and out from a wire tower located centrally on the roof.

The system of distribution is virtually a double two-wire system, having three wires so arranged that one is the common negative and the other two are separate positives; one of the latter being for the arc circuit and one for the commercial circuit. This enables a separation of the arc and commercial services controllable at the station.

There are two centres of distribution to which feeders are run and from which sub-feeders lead to distributing mains. There are two of these mains which form closed rings about the territory to be covered, and are connected by tie mains. The lamp loops are connected across the mains, and in some

* New York *Electrical Engineer.*

cases between the mains and the sub-feeders. The line poles are 30 feet long and the lamp poles 35 feet, all set one-fifth of their length in the ground, and guys are avoided where possible. The lamps are suspended from $\frac{3}{8}$-inch galvanised, stranded steel cable secured to the heads of the poles by means of adjustable eye-bolts. Sleet-proof pulleys are used, one in the centre of the cables and the other swivelled to the poles. The hoisting ropes are $\frac{1}{4}$-inch galvanised stranded steel cables, with hemp core, and are secured at lower end by oblong rings slipped over hooked pins, with "Yale" padlocks fastened through the eye in the hook. The arc lamps are of the "Manhattan" enclosed type, designed to operate two in series on 220 volts, consuming four amperes per pair of lamps, and burning 150 hours with one pair of carbons without re-adjustment.

The results of operation have been gratifying on account of mellow, steady light, with such perfect diffusion as to cause entire absence of shadow under the lamps; also uniformity of current consumption, with very low flushing current on starting. Both ampere and voltmeter needles stand perfectly steady during the operation of the plant, giving an excellent illustration of the uniformity of the load.

The incandescent lamps are 220 volt 16 candle-power lamps, with single filaments, and, so far as we have been able to judge, are a success; they appear to withstand a greater range of voltage than the 110 and 50 volt lamps. In fact, we have run some of our lamps on over 265 volts for considerable periods of time without noticeable injury.

The operation of this plant, though extending over only a short time, has been of such satisfactory a nature as to impress all who have examined it, beside proving a complete refutation of many vehement statements made by the representatives of some of our leading manufacturers of series lamps.

Persons interested in the installation of lighting plants for this purpose or in the improvement of existing plants, will find the examination of this plant valuable to them, and the writer will be pleased to furnish any further information that may be desired.

INTERNATIONAL TELEGRAPH CONFERENCE AT BUDA PESTH.

[*Translated from the Journal Télégraphique, August*, 1896.]

In our June issue an account was given of the opening ceremony of the above-mentioned Conference, held on June 16th, and the following is a complete account of the work done during six plenary meetings, the last of which took place on July 22nd.

On the whole, the results of the Conference have been of little importance, excepting that it has been a memorable episode in the history of telegraphy, and benefits have accrued to the public.

Considerations of greater importance, and other obstacles of a serious nature, prevented the unification and reduction of tariffs, and it is hoped that an amelioration in the economic conditions of Administrations will in the future eliminate opposition to progress in this direction.

Plans are more easily formulated than realised, and in view of the difference of the working of the postal and telegraph systems, it is impossible to manage one on the basis of the other. Light has, however, been cast on such questions, and a way has been smoothed towards arriving at a solution.

One of the important features was the presence of representatives from various South American States, as showing a move towards telegraphic union and the growth of international traffic consequent upon the laying of new submarine cables, has evidently convinced them of the advantages to be derived from a uniform set of rules. Hitherto the Argentine Republic and Brazil have been the only adherents in this part of the world.

Mr. Matzenauer, representative of Venezuela, having received from the Nicaraguan Government authority to represent also that State at the Conference, said the St. Petersburg Convention bound countries to lay cables which could not very well be done by those only possessing limited resources. His country appreciated the importance of a universal union, and as funds necessary for the construction of a canal connecting the Atlantic with the Pacific had been guaranteed by the United States of North America, which would redirect the commerce of the world, the importance of telegraphs was not lost sight of.

Mr. Raymond, in reply, said that Mr. Matzenauer had misunderstood Art. 4 of the Convention, which merely made it obligatory to governments to provide a proper transmission of international telegrams, and consequently to join their national to the general systems.

Notice had been sent by Mr. Matzenauer saying that since 1888 a cable had been laid from La Guayra to Curaçao, joining Venezuela with the outer world. It appeared on the map of 1889 under the title of "Comunicacion telegrafica submarina con todos los Paises de Europa," and this cable did not probably belong to the Venezuelan Government. Brazil, Japan, and British India were only joined with the international system by cables belonging to private companies.

Before 1889, even Great Britain communicated only with the European continent and the United States through private cables. This showed that Venezuela, up to the present, had fulfilled obligations imposed by Article 4, and he desired Mr. Matzenauer to explain matters to his Government, when it was hoped they would become official adherents. It was finally announced at the fifth meeting that with Nicaragua and Peru this had taken place.

The simplification and acceleration of the exchange of international meteorological advices by telegraph suggested by Switzerland, although recognised as of interest, could not be entertained on account of the difficulties it would cause in transmission and order of telegrams on lines where the traffic was considerable, as it was desired that such telegrams sent by observation stations should have priority, and all meteorological stations and observatories should be connected by telegraph to central telegraph stations, and the advices dispatched thence as multiple telegrams.

International System.

The most important modifications made which come under the above heading are as follows:—

It has been usual to take tests on Sunday mornings, but as the *personnel* at some stations is not large, and as it was important all tests should be taken so as to avoid interruption of service, paragraph 2 of Article 11 has been modified as follows:—

Paragraph 2.—Tests for the purpose of ascertaining the condition of international wires are to be taken at least once a month, on days and at hours fixed mutually by the offices concerned. The results are to be recorded in books kept for this purpose.

As most of the European States have adopted the mean time of Central Europe, paragraph 7 of Article 4 has been constructed as follows:—

Paragraph 7.—The same time is used by all offices of one State. The mean time taken by an Administration is to be notified to the Bureau International, who will make it known to all other Administrations.

In some countries the office hours are shorter than on ordinary days.

To advise the public and to avoid delays, it has been decided to add a new paragraph to Article 5:—

$\frac{C}{D\,L}$ = offices open during ordinary days, but which are only open a limited time on Sundays.

Compilation and Charging of Telegrams.

It has been decided to make several changes in the reading of Article 6, paragraph 1, and to add a paragraph specifying that plain and secret language may be employed together in the same telegram.

Considering that while marks of commerce cannot be taken as secret language, and while made up of words not belonging to the national language, and are understood, the Conference has considered it useful to add to paragraph 2 a new paragraph as follows:—

"At all times the employment in a telegram in plain language of words or current expressions not belonging to the language employed by the sender, does not give to such telegrams a secret meaning."

As Article 8 has been completely altered, and the question which it involves is of importance, the whole debate has been reviewed.

Towards the middle of the decennial period of 1860—70 there came into the telegraphic commercial use a system of correspondence, the object of which was to shorten telegrams in order to lessen the price, and also render telegrams undecipherable by anybody excepting the persons interested.

To effect this, correspondents made alphabetical codes of words, and groups of words, to which they gave a particular meaning. The words employed for this purpose were taken from all languages. Groups of letters were also employed, every one or two of which had special meanings. To facilitate the establishment of these codes, vocabularies have been published containing more than 200,000 words. Their publication is considerable, and almost exclusively done in England, where the employment of code in commercial and banking operations is very extensive.

Besides the pecuniary losses caused to the Administrations, this system was the source of a multitude of errors in transmission, and consequent claims on the part of senders.

To remedy these inconveniences, and the many abuses resulting therefrom, the Administrations restricted in Article 8 the number of languages from which words might be chosen. At the Conference of Paris in 1890, the Bureau International was ordered to prepare an official vocabulary, which was to contain all words admissible in code telegrams.

This resolution was embodied in Article 8 of the International Service Regulations revised at Paris. Employment of this vocabulary was made obligatory for all countries in the European *régime* after a period of three years, to date from its publication, its use being optional in the extra European *régime*.

After the Conference at Paris, the Bureau International, after three years' arduous work, completed, at the end of September, 1894, a vocabulary. Its issue was the cause of the greatest discontent in England, and the period during which the vocabulary was to become obligatory was consequently extended.

Publishers of codes and vocabularies, finding their interests seriously menaced by this vocabulary, organised a very violent campaign in the Press against the official vocabulary. Their virulent criticism on its contents degenerated, unfortunately, to unjust diatribes, and very little agreement resulted.

Under the influence of this agitation, which extended to all the

colonies and British possessions, the English Chambers of Commerce took the part of the English publishers of vocabularies, and addressed numerous petitions to the British Post Office protesting against the obligatory employment of the vocabulary issued by the Bureau International.

In face of these protestations the General Post Office thought they could not give their assent to a decision making the use of the vocabulary obligatory for the European *régime*.

Mr. Lamb, the delegate of Great Britain, while recognising the declaration at the meeting of the commission of regulations held to consider this matter, acknowledged the great effort and the time which had been expended by the Bureau International in completing this work. He said that the issue by that office of a vocabulary of which the number of words were sufficient for the needs of commerce, and one different from the others already issued, was a matter of impossibility. To his mind, the vocabulary presented inconveniences which did not appear in the thousands of English words which appear in the different codes, because they resemble words of other languages, and it was a matter of extreme importance to the English merchants to be able to employ in their code telegrams as many words of their own language as possible. Under the circumstances, the obligatory adoption of the vocabulary to the exclusion of all words not appearing therein, would necessitate nearly the complete revision of all codes now in use, besides causing the merchants considerable expense.

The motion of the delegate of Great Britain was seconded, and identical observations were made by the British Indies, South Africa, Persia, and all Australian colonies, who were all opposed to the obligatory use of the official vocabulary for the extra European *régime*.

Representatives of different Eastern and trans-Atlantic cable companies also endorsed these observations.

On the other hand the French delegate, supported by Belgium and Japan (who demanded, with Switzerland, that the use of the vocabulary should be obligatory to the extra European system), expressed the opinion that the adoption of an official vocabulary was one of the most important decisions of the Paris Conference, and the benefits which would result from this should not be lost by renouncing the obligatory use of the vocabulary.

They recognised, however, that it was necessary to make alterations, by replacing, for example, the words acknowledged as bad by better ones, and by making an index of the terminations.

To arrive at an agreement on the question, the French delegate proposed the following resolution:—

"From a date to be fixed by a future conference, all the words employed in private telegrams in code, are to be taken from the official vocabulary prepared by the Bureau International, properly augmented."

This proposition was unanimously adopted by the Commission, and the new compilation was ensured and was accepted by the Conference without discussion.

After the adoption of another proposition of the French delegate, relative to the employment of proper names as code words, Article 8 was altered as follows:—

New Construction.

1. Code language is understood to be that which is composed of words which do not form comprehensive phrases in one or more of the languages authorised for the use of telegrams in plain language.

2. Code words must not exceed 10 characters in length in the Morse alphabet. They must be taken from one or more of the following (eight) languages, viz., German, English, Spanish, French, Dutch, Italian, Portuguese, and Latin.

3. Proper names cannot appear in telegrams written wholly or partly in code, and are only admitted with their meaning in plain language. However, proper names taken from the official vocabulary may be used as code words.

4. The sending office may request the sender to produce his code, for the purpose of assuring themselves that the three former regulations have been properly carried out.

5. After a date, to be fixed by a forthcoming conference, all words employed in private code telegrams must be taken from the official vocabulary prepared by the Bureau International des Administrations Télégraphiques, duly augmented.

In Article 9 an addition is made to paragraph 2 prohibiting, in a more precise manner, the use of letters, or groups of letters, having a secret meaning in private telegrams written in cipher language, confirming, on the other hand, the decision adopted by the Conference on the subject of marks of commerce (*vide* Article 7), making some allowance in a like manner for letters representing signals of universal commercial codes employed in semaphoric telegrams.

(*To be continued.*)

LOCOMOTIVES ON HIGHWAYS ACT, 1896.

A.D. 1896. An Act to amend the Law with respect to the Use of Locomotives on Highways.

[August 14th, 1896.]

Be it enacted by the Queen's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

Exemption of light locomotives from certain statutory provisions.

1.—(1.) The enactments mentioned in the schedule to this Act, and any other enactment restricting the use of locomotives on highways and contained in any public general or local and personal Act in force at the passing of this Act, shall not apply to any vehicle propelled by mechanical power if it is under 3 tons in weight unladen, and is not used for the purpose of drawing more than one vehicle (such vehicle with its locomotive not to exceed in weight unladen 4 tons), and is so constructed that no smoke or visible vapour is emitted therefrom, except from any temporary or accidental cause; and vehicles so exempted, whether locomotives or drawn by locomotives, are in this Act referred to as light locomotives.

Provided that—

(*a*) the council of any county or county borough shall have power to make byelaws preventing or restricting the use of such locomotives upon any bridge within their area, where such council are satisfied that such use would be attended with damage to the bridge or danger to the public:

(*b*) a light locomotive shall be deemed to be a carriage within the meaning of any Act of Parliament, whether public, general or local, and of any rule, regulation, or byelaw, made under any Act of Parliament, and, if used as a carriage of any particular class, shall be deemed to be a carriage of that class, and the law relating to carriages of that class shall apply accordingly.

(2.) In calculating for the purposes of this Act the weight of a vehicle unladen, the weight of any water, fuel, or accumulators, used for the purpose of propulsion, shall not be included.

Regulations as to lights.

2. During the period between one hour after sunset and one hour before sunrise, the person in charge of a light locomotive shall carry attached thereto a lamp so constructed and placed as to exhibit a light in accordance with the regulations to be made by the Local Government Board.

Locomotives to carry a bell.

3. Every light locomotive shall carry a bell or other instrument capable of giving audible and sufficient warning of the approach or position of the carriage.

Rate of speed.

4. No light locomotive shall travel along a public highway at a greater speed than 14 miles an hour, or than any less speed that may be prescribed by regulations of the Local Government Board.

Use of petroleum, &c. 34 & 35 Vict. c. 105. 42 & 43 Vict. c. 47. 44 & 45 Vict. c. 67.

5. The keeping and use of petroleum or of any other inflammable liquid or fuel for the purpose of light locomotives shall be subject to regulations made by a Secretary of State, and regulations so made shall have effect notwithstanding anything in the Petroleum Acts, 1871 to 1881.

Local Government Board regulations.

6.—(1.) The Local Government Board may make regulations with respect to the use of light locomotives on highways, and their construction, and the conditions under which they may be used.

(2.) Regulations under this section may, if the Local Government Board deem it necessary, be of a local nature, and limited in their application to a particular area, and may, on the application of any local authority, prohibit or restrict the use of locomotives for purposes of traction in crowded streets, or in other places where such use may be attended with danger to the public.

All regulations under this section shall have full effect notwithstanding anything in any other Act, whether general or local, or any byelaws or regulations made thereunder.

Every regulation purporting to be made in pursuance of this section shall be forthwith laid before both Houses of Parliament.

Penalties.

7. A breach of any byelaw or regulation made under this Act, or of any provision of this Act, may, on summary conviction, be punished by a fine not exceeding £10.

Excise duty on certain locomotives. 51 & 52 Vict. c. 8.

8.—(1.) On and after January 1st next, after the passing of this Act, there shall be granted, charged, and paid in Great Britain for every light locomotive, which is liable to duty either as a carriage or as a hackney carriage under Section 4 of the Customs and Inland Revenue Act, 1888, an additional duty of excise at the following rate, namely:—

	£	s.	d.
If the weight of the locomotive exceeds one ton unladen, but does not exceed two tons unladen	2	2	0
If the weight of the locomotive exceeds two tons unladen	3	3	0

(2.) Every such duty shall be paid, together with the duty on the license, for the locomotive as a carriage or a hackney carriage, and shall in England be dealt with in manner directed with respect to duties on local taxation licenses, within the meaning of the Local Government Act, 1888; and in Scotland be paid into the Local Taxation (Scotland) Account, and be dealt with as part of the residue within the meaning of Section 2, Sub-section (3), of the Local Taxation (Customs and Excise) Act, 1890. 51 & 52 Vict. c. 41. 53 & 54 Vict. c. 60.

Construction of wheels of locomotives on roads.

9. The requirements of Sub-section (4) of Section 28 of the Highways and Locomotives Amendment Act, 1878, may be from time to time varied by order of the Local Government Board.

Application to Scotland.

10. In the application of this Act to Scotland a reference to the Secretary for Scotland shall be substituted for a reference to the Local Government Board, a reference to the road authority of any county or burgh for a reference to the council of a county or county borough, and a reference to Sub-section (4) of Section 3 of the Locomotives Amendment (Scotland) Act, 1878, for a reference to Sub-section (4) of Section 28 of the Highways and Locomotives Amendment Act, 1878. 41 & 42 Vict. c. 58.

Application to Ireland.

11. In the application of this Act to Ireland a reference to the Local Government Board for Ireland shall be substituted for a reference to the Local Government Board, and a reference to the council of a county shall be construed in an urban sanitary district under the Public Health

Vict. c. 52. (Ireland) Act, 1878, as a reference to the urban sanitary authority, and elsewhere as a reference to the grand jury.

Short title and commencement. 12. This Act may be cited as the Locomotives on Highways Act, 1896, and shall come into operation on the expiration of three months from the passing thereof.

SCHEDULE.

Enactments which are not to apply to Light Locomotives.

The Locomotives Act, 1861 (34 & 25 Vict. c. 70), except so much of Section 1 as relates to tolls on locomotives, and Sections 7 and 13.

Section 41 of the Thames Embankment Act, 1862 (25 & 26 Vict., c. 93).

The Locomotives Act, 1865 (28 & 29 Vict., c. 83).

The Locomotives Amendment (Scotland) Act, 1878 (41 & 42 Vict., c. 58).

Part II. of the Highways and Locomotives (Amendment) Act, 1878 (41 & 42 Vict., c. 77).

Section 6 of the Public Health (Ireland) Amendment Act, 1879 (42 & 43 Vict, c. 57).

THE INTERNATIONAL CONGRESS OF ELECTRICIANS AT GENEVA.

(*Continued from page* 266.)

The third communication on August 6th was made by Herr Rothert, on a new three-wire machine. One objection to the three-wire system as at present carried out is the necessity of having at the central station two small machines instead of one large one. Electrical engineers have now for some years been trying to construct a single machine which will be capable of working a three-wire network. None of the solutions, however, up to the present have succeeded in satisfying all the requirements. If a third brush is laid on the collector of a direct current dynamo half-way between the positive and negative brush, the middle wire can be connected to this third brush; but the brush will spark violently, owing to the fact that it lies in the middle of the strongest magnetic field, and regular working is thus out of the question. A better solution consists in furnishing the armature of the dynamo machine with two separate windings and two collectors, connected one behind the other, the neutral brush being placed between the two. This plan, within certain limits, will work well.

Dobrowolsky has devised a very interesting way of converting any ordinary dynamo into a three-wire machine, and according to this design, the three-wire machines of the Allgemeine Electricitäts Gesellschaft, and of the Compagnie de Fives Lille, are made. In an armature, two fixed points of maximum P.D. are connected by means of collector rings through a choking coil, and to the middle of this choking coil the neutral wire is connected.

The two methods just described cannot possibly keep the tension of the two branches equal with variations of load; and, besides, both these methods add considerably to the cost of the machine.

Such were the solutions proposed of the three-wire machine problem till about two years ago, when the machine which was the subject of Herr Rothert's paper was invented by Herr Dettmar. At the present time several of these machines are in use. This machine is constructed on the principle already mentioned of interposing a third brush half-way between the positive and negative brushes of an ordinary dynamo. To prevent sparking, each pole is divided into two parts. This is carried out in practice by combining a two-pole wound armature with a four-pole magnet. The middle brush is applied in the neutral zone between two like named poles of the magnet. As has been shown by many experiments, there is then a complete absence of sparking at the middle brush. When the machine is working, the lines of force in the armature near N_1 and S_1 act against the lines of force in the external field, and those near N_2 and S_2 act in the same direction. The result is that the poles N_1 and S_1 will be weakened by the armature reaction, while poles N_2 and S_2 will be strengthened. Since two opposite poles of unlike name induce the same branch of the three-wire tension, both tensions will change when the load comes on; the tension of the branch 1 – 0 will fall, and that of the other will rise. If the tensions are to remain equal, the excitement of the bobbins, N_1 S_1, must be strengthened, and that of the bobbins, N_2 and S_2, must be correspondingly weakened, to neutralise the influence of the armature reaction. In practice, the bobbins, N_1 and S_1, are connected in series, and so also are N_2 and S_2. Since two opposite poles induce only one branch of the tension, by changing the induction of their bobbins, this branch of the tension can be regulated as desired, in fact, one branch of the tension may be reduced to zero, while the other branch remains at its normal value. The idea of dividing a pole for the insertion of a third brush has already been proposed by Muller and by Kingdon. Kingdon, however, connected the bobbins of like named poles together, so that there was no regulating effect as in the Dettmar-Rothert dynamos. Machines with eight poles have been made on this design, and they can also be designed to suit the four and five-wire system. It turned out, however, in practice, that the machine had the undesirable property of undergoing partial depolarisation. If we imagine, for instance, the bobbins, N_2 and S_2, cut out, and the poles, N_1 and S_1, excited, the lines of force incline to go to the adjacent poles and partially depolarise them. This can be counteracted by causing the two branches to reciprocally excite one another; *i.e.*, the bobbins, N_1 and S_1, are connected to the terminals, 0 – 2, and conversely the bobbins, N_2 and S_2, to 1 – 0. One branch can now only be excited when the other already shows tension, or the two branches must simultaneously develop tension. The Dettmar-Rothert machine is made by the Elektricitäts Actien Gesellschaft, Frankfort-on-Main.

On August 8th M. Hospitalier made a report on the magnetic units proposed by M. Blondel, which we published last week. The Congress almost unanimously declined to accept the proposed new names, as being unnecessary, and likely to lead to confusion; it was considered that the C.G.S. units answered every purpose, and that no special names were necessary.

The next point in the discussion was the protection of heavy current installations from lightning. A report on this subject was read by M. Chavannes. He pointed out that atmospheric discharges always strike that conductor which offers them the easiest path to the earth. The position of the conductor has very little influence; in some cases it is the upper wire, in other cases it is the lower wire which is most frequently struck. In order to protect all the wires, the lightning conductor should offer a much easier path to the earth than any of the power conductors. It should, therefore, have the smallest possible resistance and self-induction. The report recommends that lightning conductors be made as straight as possible, and have good earth connections. Very valuable machines in direct current installations should be protected by large choking coils. In the case of alternate current installations this is not possible, and consequently the leads themselves must be protected as thoroughly as possible by lightning conductors all along the lines. Fusible wires are of no use; but self-acting spark extinguishers are absolutely necessary. In the case of alternate current installations, complete protection against lightning can be attained by connecting all the poles to earth through a water resistance. Where water is present, as in the case of turbine driving, this plan can be carried out, though it is accompanied by a small loss of current. The protection of transformers is of especial importance. At St. Etienne, the insulation of both bobbins of a transformer was injured by a small lightning stroke; the low potential coils thus became high tension, and a man was killed by touching a switch in the secondary circuit.

The report gave no decisive judgment on the value of condensers in lightning protecting apparatus. Like most apparatus, they are efficient when properly applied. They must not be brought too near to each other or to other conductors, so that the spark, when the apparatus interrupts it, may not spring back. The smallest permissible distance is 30 to 40 cm. If the switchboard is made larger by this, the security is considerably increased. Underground cables require safety devices for both poles.

In the discussion on this report, M. Thury said that in the case of installations up to 500 volts tension, insulation of the base of the machine from the earth was not necessary. The insulation of the machine itself is relatively thin, and the discharge goes through it without injuring it. In the case of high tension installations, however, the insulation of the machine must be very strong, and it will probably be destroyed in a particular spot by the passage of this discharge. To prevent this, the base of the machine must be insulated from the earth. The attendants, of course, must be insulated from the earth by a platform standing on porcelain bells. A very reliable lightning protector, which the speaker had recently introduced, was a modification of the Wood apparatus with carbon points, which were separated by the passage of the heavy current through an aluminium lever.

M. Görges described the apparatus which had been used with great success at Wynau, where one of the hydro-electric plants visited by the Congress is situated. It consists of two stout copper wires bent to the shape of a ∪, and fixed side by side, so that the horizontal parts are closest together, and the vertical shanks gradually diverge as they rise upwards. When an arc is formed between the horizontal parts, it is forced upwards by the hot air currents and the electrodynamic forces, till it is broken by the increased length of the air space between the vertical shanks. For moderate tensions, M. Görges recommends the zinc antimony alloy of Wurts.

M. Hillairet considered that lightning striking the lines directly was not dangerous for the machines. According to his experience, these discharges seldom reach the end of the lines, but pass to the earth directly by destroying one of the insulators, especially if the poles stand in damp soil. In mountainous regions all the poles should have lightning conductors. The currents induced in the conductors by distant lightning discharges are, however, dangerous for the machines. Even in regions which are not often visited by thunderstorms, it is advisable to have lightning protectors, since the speaker had observed, in connection with an installation in North Africa, that these apparatus often came into action when the sky was cloudless. The insulation of the machines from earth he considered to be advantageous; he recommended zinc as the best material for pointed lightning conductors.

At the end of the discussion, Prof. Palaz proposed the following resolution:—"The Congress, acting on the recommendation of the Verband Deutscher Elektrotechniker, of the Swiss Elektrotechniker Verein, and of the Société Belge des Electriciens, expresses the wish that the electro-technical societies of the different countries will endeavour to further the solution of the problem of lightning protection by the publication of their observations."

The rest of the morning sitting was occupied by a communication by Raoul Pictet, upon "The Influence of Low Temperatures upon the Conductivity of Metals, and upon the Action of the Cathode Rays."

In the afternoon sitting, the reports of committees were received. The report on disturbances in telephone conductors by street railway currents, as has been already mentioned, was sanctioned by the Congress without any alteration. But the report on photometric units was not so fortunate. This had been prepared by a commission of eight members, under the presidency of Herr von Hefner-Alteneck.

The tenor of this report, to which we briefly alluded in our issue of August 14th, was as follows:—

1. The international photometric magnitudes are based on the intensity of light of a luminous point, and are set down in the following table:—

Name.	Symbol.
Intensity of light	I
Flux of light	$\phi = I_w$
Illumination	$E = \frac{\phi}{S}$
Brightness	$e = \frac{I}{S}$
Quantity of light	$Q = \Phi T$

In the above, ω is a solid angle, S a surface, which in the formula for illumination is to be stated in m^2, and in the formula for brightness, in cm^2. T is the time in hours.

2. The unit of intensity of light is the candle.

3. Temporarily, as a good approximation for industrial purposes, the candle may be represented by the horizontal intensity of the Hefner lamp, the necessary corrections being taken into account.

The Commission has also, after discussion with the English and Italian members of the Congress, prepared the following table for the names of the different magnitudes in different languages. This table was communicated to the Congress, but the discussion was entirely confined to the French designations.

English.	German.	French.	Italian.
Intensity of light	Lichtstärke	Intensité lumineuse	Intensita luminosa
Flux of light	Lichtstrom	Flux lumineuse	Flusso luminoso
Illumination	Belichtung	Eclairement	Illuminamento
Brightness	Erhellung	Eclat	Splendore
Quantity of light	Lichtleistung	Eclairage	Illuminazione

The discussion in the full Congress turned entirely on the question as to whether the name for the unit of the intensity of light was to be qualified by an addition to the word "candle." Prof. Mascart proposed to substitute for this the term "bougie decimale." This question had been very thoroughly discussed in committee, but was rejected by a majority of seven to one, because the "bougie decimale" was derived from the Violle platinum unit, which latter, though proposed thirteen years ago, had not yet been exactly determined. This point was clearly brought out in the discussion in the full meeting by Dr. Köpsel, who said that the Reichsanstalt, after the most careful experiments, found a variation of 25 per cent. in their determinations of the Violle unit. The German members of the committee had then pointed out that it would be unpractical and illogical to derive a more exact and a more easily determined unit from one which was less so. Herr von Hefner-Alteneck especially protested against the standardising of two units between which no certain relation could be established.

The result of the discussion was that the Congress accepted the first resolution of the committee, but modified the second and third by substituting for "bougie" (candle), "bougie décimale." The Congress therefore says: "We recognise the twentieth part of the Violle unit as the theoretically exact unit of intensity of light, but as we cannot practically determine this, we take the intensity of the Hefner Alteneck lamp as the unit."

ELECTRIC AND MAGNETIC RESEARCH AT LOW TEMPERATURES.

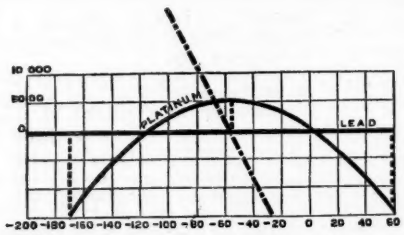
By Professor J. A. FLEMING, M.A., D.Sc, F.R.S, *M.R.I.*, Royal Institution of Great Britain—Weekly Evening Meeting, Friday, June 5th, 1896

The Right Hon. Lord Kelvin, D.C.L., LL.D., F.R.S., Vice-President, in the chair.

(*Continued from page* 285.)

The events which under such conditions happen in the case of a platinum-lead junction can easily be shown, and are very interesting (see fig. 12). At the first immersion of one junction in liquid air, whilst the other is in melting ice, we get a current as shown by the galvanometer in one direction. On lifting one junction out of the liquid air it begins to warm up. The first effect of this heating is to reduce the thermo current in the circuit. At about − 111° on our platinum scale, some distance therefore above that of liquid air, the current in the circuit falls to zero. As the junction continues to heat up, the current increases again in the opposite direction. At about − 60° the low temperature junction reaches the temperature called the neutral temperature, and the current is a maximum in one direction. It then begins to fall off once more, and finally becomes zero again when the two junctions are both at the temperature of melting ice, and it lastly increases in the opposite direction as this variable junction continues to warm up from 0° C. to higher temperatures.

Having carried out the observations described with all our thermo couples, the results were represented on a chart (see fig. 13) as follows:—A horizontal line was taken on which were marked off



Curve of thermo-electromotive force of a platinum-lead couple at various temperatures; one junction kept at 0° C., the temperature of the other being varied. The sloping dotted line represents the variation of the thermo-electric power of platinum with respect to lead.

Fig. 12.

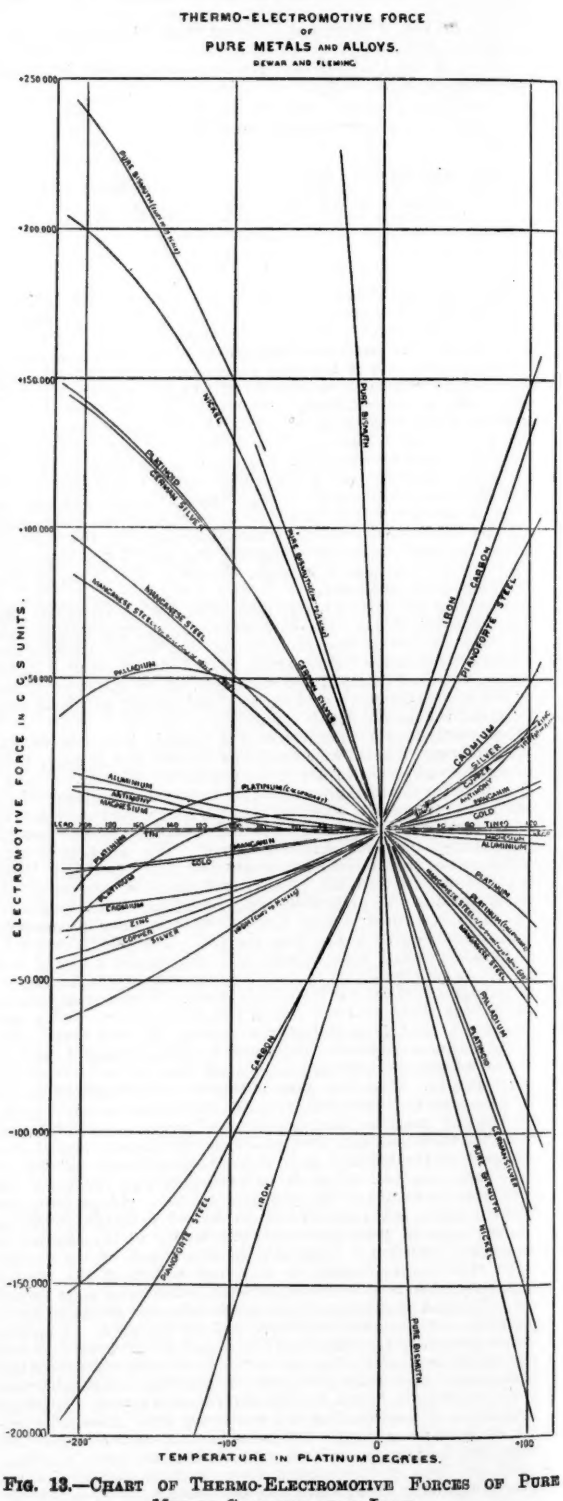
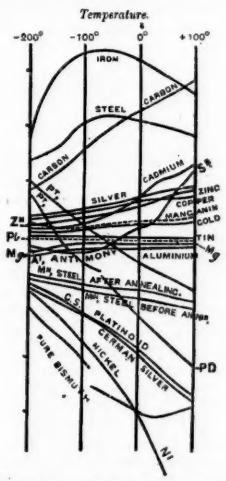


Fig. 13.—Chart of Thermo-Electromotive Forces of Pure Metals Compared with Lead.

divisions representing platinum temperatures. Vertical ordinates were then drawn at various temperatures for each couple, representing the electromotive force in this couple when the cold junction was at the temperature denoted by the abscissa of that ordinate. In this way a series of curves were delineated which all passed through the point representing 0° C. These curves are the curves of thermo-electromotive force.

In Professor Tait's researches on this subject he adopted a method of representing the facts which has many advantages. Suppose the couple to have one junction at a constant temperature, and the other to be varying. At any instant the electromotive force of the couple is varying at a certain rate with the changing temperature of the non-constant junction. This rate measures what is called the *thermo-electric power* of the metals with respect to each other at that temperature. If we measure the slope of the electromotive force curve at any point, it can easily be shown that the numerical value of this slope gives us the rate of change of electromotive force with temperature. If we plot these slopes in terms of the corresponding temperature, we obtain another set of curves called curves of thermo-electric power. Lead is always taken as the standard metal for comparison, because the Thomson effect in lead is zero. From our chart of thermo-electromotive forces we have constructed another one of thermo-electric powers (see fig. 14). The lines of thermo-electric power cut the lead line in various places, and the temperature at which they do



Curves showing the variation with temperature of the thermo-electric power of various metals. The thermo-electric line of lead being represented by the dotted line.

FIG. 14.

this is called the neutral temperature of that metal with respect to lead. Professor Tait deduced from his experiments that these thermo-electric lines were straight lines for temperatures above zero Centigrade, and he made, in addition, the important discovery that for certain metals such as iron and nickel the thermo-electric lines have sudden changes of direction at high temperatures.

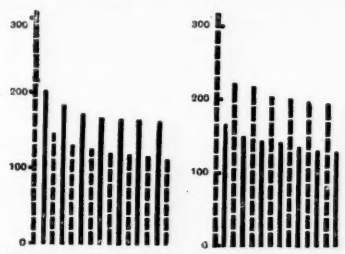
The general result of our investigations at low temperatures is to show that, whilst in some cases the thermo-electric lines, as may be seen from the diagram in fig. 14, are approximately straight lines for temperatures down to the lowest reached, they are not all by any means straight lines. In some cases, such as iron and bismuth, we find sudden changes of direction of the thermo-electric lines similar to those found by Professor Tait at higher temperatures, and this indicates a change in sign in the Thomson effect at that point. Moreover, in many cases there is a decided tendency of the lines of many metals to bend round in a manner which indicates that their thermo-electric power probably would become zero at the absolute zero of temperature.

The temperature at which the thermo-electric line of any metal crosses the line of lead gives us the neutral temperature of that metal with respect to lead, and at that temperature the metal is thermo-electrically identical with lead. If one junction of a couple is at a temperature as far above the neutral temperature of the metals as the other is below it, the couple will give no electromotive force. This provides us with an experimental method of determining the position of certain neutral points. Thus, for instance, if one junction of a platinum-zinc couple is placed in liquid air and the other is raised to above 30° we get no electromotive force from that couple. This indicates that the neutral temperature of platinum and zinc is about −85°, and this is shown to be the case from the chart. Two general conclusions are arrived at from a study of the thermo-electric lines as laid down in our chart. The first of these is that the thermo-electric lines of many metals are by no means straight lines over extreme ranges of temperature. Hence the thermo-electric power is not simply a linear function of the absolute temperature. The second important fact is, that in the thermo-electric lines of certain metals at low temperatures there are sudden changes of direction which indicate a change in the sign of the Thomson effect in that metal at that temperature, and probably, therefore, some important molecular change at the corresponding temperature.

In the case of the 19 and 29 per cent. nickel-steel alloys, there is an interesting thermo-electric phenomenon. If a loop of wire of this material is partly dipped in liquid air, the portion cooled becomes thermo-electrically different from the remainder, and gives a strong thermo current if connected to a galvanometer and warmed at one point, where the changed and unchanged portions meet.

Leaving the further elaboration of these points, we must next notice some of the facts with respect to the magnetisation of iron at low temperatures. Prof. Dewar mentioned, in a discourse on the scientific uses of liquid air, some results obtained on cooling small steel magnets. These effects we have since again explored at greater length.

Let me show you, in the first place, the effect of cooling a small steel permanent magnet to the temperature of liquid air. We will first take a magnet made of a fragment of knitting needle or ordinary carbon steel, and examine the effect of low temperature upon it. Placing the magnet behind the small suspended magnetic needle of a magnetometer, we obtain a deflection of the magnetometer needle, which is a measure of the magnetisation of the magnet causing the deflection. On bringing up a small vessel of liquid air and immersing in it the magnet under test we notice at once a sudden decrease in the deflection of the magnetometer needle. This indicates that a notable percentage of the magnetisation of the magnet has been removed. On taking away the liquid air bath and allowing the magnet to heat up again, we find that there is a still further decrease in magnetisation. On cooling it again with liquid air the magnetisation



Soft Carbon Steel. 19 per cent. Nickel Steel.

Diagram showing changes of magnetic moment of a magnet when alternately cooled in liquid air and warmed up again to + 5° C. The length of the firm lines represents the value of the magnetic moment when cooled, and that of the dotted when warm.

FIG. 15.

then increases, and from and after that time the effect of the cooling is always to increase the moment of the magnet, and the effect of heating it up again always to decrease the moment of the magnet. Hence we see that the effect of the first immersion in liquid air is to give a shock to the magnet which deprives it permanently of a considerable percentage of its magnetism; but when once it has survived this treatment, then cooling it strengthens the magnet, and warming it weakens it.

This is not by any means always the case. If we take a magnet made of the 19 per cent. nickel-steel, the peculiar characters of which were explained a few moments ago, we shall find a very different state of affairs. Here we see the first effect is, as before, to remove a very considerable percentage of the initial magnetisation; but after that stage is passed, then cooling this nickel-steel magnet always weakens it still more, and warming it up again strengthens it. The subsequent effect of cooling is therefore in the opposite direction in the carbon-steel and in this nickel-steel. These changes of moment can best be represented by a diagram of lines as in fig. 15.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

NEW PATENTS.—1896.

18,191. "Improvements in galvanic batteries." J. Brandt. Dated August 17th.

18,196. "Improvements in the construction of tubes and tubular electric conductors." J. D. F. Andrews. Dated August 17th.

18,205. "Improvements in electrically operated carillons." E. H. Carqueville. Dated August 17th.

18,220. "An improved meter or apparatus for registering the consumption of alternating electric current." J. Y. Johnson. (Hartmann & Braun, Germany.) Dated August 17th. (*Complete.*)

18,249. "An improvement in the preparation of filaments for glow lamps." W. S. T. Martin and H. Weymersch. Dated August 18th.

18,273. "Improvements in dynamo-electric machines." H. H. Lake. (R. Lundell and E. H. Johnson, United States.) Dated August 18th. (*Complete.*)

18,312. "Improvements in induction telegraphy." S. Eversheд. Dated August 18th.

18,317. "A new or improved device for use in connection with electric railways." F. C. Esmond. Dated August 18th.

18,319. "A new or improved electric hand lamp for general or special purposes." A. J. Westmancott. Dated August 19th.

18,324. "Improvements in motors applicable to machinery, velocipedes, steam, gas, or electric engines and the like." W. H. Parkes. Dated August 19th.

18,326. "Improved preparations for accumulator plates." H. Weymersch. Dated August 19th.

18,364. "An improved electric motor or dynamo-electric machine." J. T. Knowles. (J. H. de Thierry, Italy.) Dated August 19th.

18,408. "Improvements in the production of electric light." J. Dobson. Dated August 19th.

18,420. "The practical application of the electric light to bicycles, tricycles, carriages, and all motor cars." F. Ritchie. Dated August 20th.

18,454. "Improvements in incandescent electric lamps." J. M. Huisman and H. C. Gover. Dated August 20th.

18,464. "Improvements in electric gas lighters." E. Orling. Dated August 20th. (Date applied for under Patents, &c., Act, 1883. Sec. 103, April 23rd, 1896, being date of application in Sweden.)

18,469. "Improved method of and means for attaching telegraph and other wires to insulators." G. Middleton. Dated August 20th.

18,479. "Improvements in the manufacture of electric cables." M. J. P. O'Gorman. Dated August 20th.

18,485. "Improvements in acid-proof electrical non-conducting articles and composition therefor." W. Morison. Dated August 20th.

18,497. "Improvements in electrical measuring and signalling instruments." H. W. Sullivan. Dated August 20th.

18,537. "Apparatus intended to determine the quantity of metal which a galvano-plastic bath should deposit on the object treated." J. Ducot. Dated August 21st.

18,549. "Improvements in or relating to electrical primary batteries." J. B. Whittemore. Dated August 21st. (*Complete.*)

18,570. "Improvements in electric batteries." F. Dannert. Dated August 21st. (*Complete.*)

18,580. "Improvements in and relating to electrical ceiling roses, switches and the like." W. McGeoch. Dated August 22nd.

18,593. "An improvement in electrical apparatus." J. F. Kelly. Dated August 22nd. (*Complete.*)

18,628. "Incandescence body for electrical glow lamps and process of manufacture of the said body." J. F. Bachmann. Dated August 22nd. (*Complete.*)

18,632. "Improvements in holders for incandescence electric lamps, also applicable to the holding of the shades or reflectors thereof." (H. Hirst and G. E. Fletcher.) Dated August 22nd.

18,648. "Improvements in electrical storage or secondary batteries." R. Kennedy. Dated August 22nd.

18,649. "A new or improved recording electricity meter." R. Kennedy. Dated August 22nd.

18,651. "Improvements in commutator brushes for dynamo-electric machines or electric motors." H. H. Lake. (R. Lundell, United States.) Dated August 22nd. (*Complete.*)

18,652. "Improvements relating to electric railways." H. H. Lake. (R. Lundell, United States.) Dated August 22nd. (*Complete.*)

ERRATUM.—New Patents, 1896.—Electrical Review, No. 977, page 222, application No. 17,093. The applicant's name should be G. M. Sellick, instead of the name as stated.

EXPIRING PATENT.—1882.

We are informed by Messrs. W. P. Thompson & Co. that about 70 applications for electrical patents were filed in the month of September, 1882. Only one of the patents granted on these applications has been maintained to run its full length of term, and as it is of considerable interest, we give an abstract of it below:—

4,419. "Improvements in electric arc lamps." J. Brockie. Dated September 16th, 1882. A dash-wheel consisting of a hollow disc, drum or cylinder, is mounted on a spindle, a pinion to which gears with a rack on the upper carbon holder, to prevent the too sudden descent of the latter. The interior of the drum is divided by partitions not quite reaching to the axle, and each perforated near the periphery, and it is partially filled with a fluid such as mercury, glycerine, or oil, or with any fine granulated substance. The dash-wheel is operated by a solenoid, the core of which lifts a cam lever so that the pawl impinges against the rim of the wheel. The cam lever is pivoted to a heavier radius lever which is pivoted to the same axle as the drum, and there is a stop to limit the descent of the cam lever. The operation of the arrangement in striking the arc and in regulating the upper carbon is described. The pawl may be replaced by other devices, and various modifications may be made. A lamp having two pairs of carbons is shown, in which two discs are rotated by the core of one solenoid lifting both cam levers, but the stops are arranged at different heights, so that one pawl will grip before the other. "Or one carbon holder may be locked by a lever, which lever is withdrawn by the carbon holder of the pair first in action when it arrives at a certain point." 2 claims. An application to amend was made on December 20th, 1893, and the amendment made on April 20th, 1894.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d* (*in stamps*).]

1895.

16,659. "Improvements in and relating to electric railways." R. Belfield. (The Foreign Electric Traction Co, Ltd., United States.) Dated September 5th, 1895. Relates to systems in which exposed terminals are located at intervals along the track, which terminals are energised only when the car is above the same. The improvements consist in special constructions of the switches and switch boxes for connecting exposed terminals to the mains and to the collecting bars carried by the car, which receives the current from the exposed terminals in the track. Improved arrangements for storage batteries which are carried by the car for the purpose of actuating the electro-magnetic switches, these arrangements having for their object to enable one set of cells to be charged while another set is in discharge. A motor generator worked by the main current is also described as being used for the purpose of operating the electro-magnetic switches. 9 claims.

16,897. "Improvements in holders and supports for electrical candles." H. Hirst and W. E. Gibson. Dated September 10th, 1895. Relates to holders and supports for electrical candles and the ready adaptation of candles of any length. A tubular screwed base fitting into a voluted plug of resilient or elastic material, is provided with a slotted extension and a guide clip. The lamp-holder of any known type is mounted on said extension, and fits within the guide. Set screws are used to fix the device so that the candle lamp may be adjusted to the artificial candle of any length within the range of the slots. 3 claims.

16,898. "An improved wall socket and plug for electric lighting and kindred purposes." G. Binswanger. Dated September 10th, 1895. Relates to a form of wall socket and plug of the type generally known as "concentric," the poles being concentrated one with the other. The central connection consists of a metal plug, split or otherwise made elastic, and a metal ring concentrically placed thereto. The object of this invention is to obviate "short circuiting" in such fittings by interposing an insulating substance between the poles, so that the plug alone may make contact. 5 claims.

17,123. "Improvements in linked suspensions for electroliers, electric light pendants, and the like." H. Hirst. Dated September 13th, 1895. Relates to a linked suspension for electroliers, &c., and has for its object the insertion into the contact surfaces of each link forming the suspension, hollow plugs or bushes of insulating material through which the flexible lead may freely pass throughout the length of the suspension. The bushes are shouldered upon the side of each link opposite to that on which the strain is imposed on the suspension as a whole. 2 claims.

17,656. "Improvements in spring contact switches." B. M. Drake and J. M. Gorham. Dated September 21st, 1895. Refers to Specification 18,292 of 1890, and relates to an improved construction of contact where a large bearing surface is required. A number of independent contacts are provided with spaces between each and the next, so arranged that each acts as an independent spring, and ensures an efficient bearing against the fixed contacts. For this purpose is constructed a U-shaped piece with a receptacle at each end, into which are packed a number of sheets of brass with distance pieces between each, the whole being clamped together. The portions of the sheets which project beyond the box are bent at an angle sufficient to give them a spring action against the fixed contacts. The main adjustment of all the contacts is effected by means of a screw. 1 claim.

17,782. "An improved electric contact for use with clocks and the like." G. Wall. Dated September 24th, 1895. Provides a ready means of adjusting the position of contact so that a bell may be rung at a desired time. A ring of non-conducting material carrying two terminals of flexible or elastic material is mounted upon an inner ring secured to the dial of the clock. This inner ring may be rotated upon the outer ring, and the circuit closed when the hand passes over the contact pieces. 1 claim.

1896.

3,690. "Electro-magnetic induction system of supplying power to electrically propelled vehicles." A. C. Shuttleworth. Dated February 18th, 1896. Relates to a system of distribution of electrical energy for the propulsion of cars. The arrangements are summarised as follows:—The combination with sections of laminated iron ties of a single insulated primary conductor wound around and at right angles above and below the sections of the laminated ties in a series of convolutions or spirals, said laminated ties forming stationary parts of the magnetic circuit, a movable part of the magnetic circuit, a secondary electric circuit encircling the movable part of the magnetic circuit and automatic switches for producing a multiple or parallel arrangement of the upper and lower sections of the primary conductor when said switches are in their normal positions. 1 claim.

12,345. "Automatic apparatus for the working of telephone stations." E. Naglo. Dated June 5th, 1896. Relates to an automatic switch apparatus which, for facilitating the working of telephone stations, is combined with the plug cables for effecting the telephonic connections. The apparatus carries out several of the operations that are repeated on making each connection, in particular the inclusion and exclusion of the call bell battery and the speaking instrument of the official, such apparatus being so arranged as to be put in action by a certain manipulation of the office, and to carry out consecutively in the proper sequence and intervals of time the requisite contact makings and breakings. 1 claim.